ADMINISTRATION REPORT

OF THE

DEPARTMENT OF AGRICULTURE

For the year 1921.

BAGHDAD:
PRINTED AT THE GOVERNMENT PRESS,
1922

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ADMINISTRATION REPORT OF THE DEPARTMENT OF AGRICULTURE FOR THE YEAR 1921.

I. INTRODUCTORY.

1. Before reviewing the work of the Department for the year 1921 it would perhaps be as well to give a brief summary of its History and of the policy which it is endeavouring to pursue.

2. In 1917 a purely Military Organisation known as the Agricultural Development Scheme, whose inception is to be credited to Mr. C. C. Garbett, C.I.E., I.C.S., was formed with the primary object of increasing the production of cereals with which to feed the Army of Occupation and the Civilian population. In its early days, the Administration of this organisation was entrusted to the First Revenue Officer, Baghdad. In July, 1918, Colonel G. Evans of the Indian Agricultural Service was appointed Director of Agriculture in Mesopotamia and on his appointment he assumed charge of the Agricultural Development Scheme. A more ambitious programme of work was forthwith undertaken. Large farms were opened at Basrah, Nasiriyah, Hillah, 'Amarah, Kut, Baghdad, Kadhimain, Ba'quba, Khaniqin and Mosul. Subsequent to the Armistice in November, 1918, these farms have in turn all been closed down with the exception of the Ba'quba and Kut Farms where small areas have been retained for experimental purposes. The Cotton Farm at Karradah (Baghdad) was opened by the Cotton Expert in December, 1917; and the preliminary cotton experiments were conducted on it for three years. The Cotton Expert did not come under the Administration of the Director of Agriculture until early in 1919.

3. In March, 1919, on being transferred to the Civil Administration the Agricultural Department ceased to be a Military Organisation and it therefore ceased to function as an agency for the cultivation of cereals and vegetables with which to feed the Army of Occupation. From that date the programme of work of the Department has been framed with a view to developing the agricultural resources of the country.

4. Colonel Evans, who was in Administrative charge of the Department for nine months reverted to India in April, 1919, to be relieved by Lieut.-Colonel R. J. D. Graham, also of the Indian Agricultural Service. The latter relinquished his appointment with the Civil Administration of Mesopotamia in July, 1920. Mr. R. Thomas, officiated as Director of Agriculture from the date of relief of Colonel Graham until 21st October, 1920, when he was confirmed in his appointment.

5. Up to November, 1920, the Department of Agriculture had been under the Administration of the Revenue Secretary. On the formation of an Arab Government the Department was included in the newly formed Ministry of Interior.

6. The programme of work and the policy of the Department have, in principle, remained unchanged from the time it ceased to be a Military Organisation. Its chief function is to hasten agricultural development and thereby increase the wealth of the country and of its inhabitants. The means adopted to attain this end is perforce largely determined by the financial allotment which the Government deems fit to grant each year for the Budget Expenditure of the Department.

7. There exists very great scope for increasing the production of agricultural commodities not only by extending the areas under irrigation but also by instituting improvements on those areas already irrigated or otherwise cultivated. A most noticeable feature in the Agricultural economics of the 'Iraq is the total absence of cultivation of *summer crops* of commercial importance (other than dates) for export. Cotton is a summer crop which will fit admirably into the scheme of rotation with wheat and barley as winter crops.

8. A fairly considerable amount of attention has been given to the cotton problem in 'Iraq since 1917. The commercial cultivation of cotton for export is now fairly well established on the Diyala and on the Yusufiyah and Saqlawiyah canals, and there are signs that it will extend rapidly to other canals.

9. Other lines of work which are receiving special attention with the view to effecting an increase in the surplus production of crops are:—

(*a*) the importing and breeding of pure types of wheat and barley;
(*b*) demonstrating the use of threshing machines which ensure cereal crops being marketed clean;
(*c*) demonstrating improved methods of silk culture;
(*d*) the introduction of flax cultivation and flax machinery; and
(*e*) the controlling of insect pests of crops in general and of the date crop in particular.

10. General agricultural economics have throughout received a considerable amount of attention. It is only after a careful study, over a protracted period, has been made of the agricultural practices in vogue can so-called *improvements* be justified. Information of value on the agricultural economics of the 'Iraq is steadily accumulating.

II. THE SEASON AND ITS EFFECTS ON CROPS.

11. Agriculturally, winter and spring are the busiest seasons in the 'Iraq, and the cereal crops of wheat and barley grown during this period are the main source of agricultural revenues. The condition of the cereal crop, irrespective as to whether it is grown on irrigated or unirrigated land , is very largely determined by the extent and distribution of the winter rains. The rainy season normally extends from November to April, but the distribution within this period varies considerably with each year. The average annual rainfall for the past 33 years in Baghdad is 6·91″ and it is found that with a rainfall of 8″ evenly distributed between the months of November, December, January and February, a bumper crop of cereals can be harvested on un-irrigated land. During the 1920-21 winter season a total rainfall of 6·20″ was recorded. Of this, 2·82″ fell between September and December. Very large areas were put under cultivation as a result of these very favourable sowing rains. In January 1·63″ of rain fell in small showers, and the next heavy rain was not received until May, which was too late to be of any use to the cereal crop. The season was most unfavourable for unirrigated crops. In addition, the large areas sown with cereals in the riverain tract failed to profit from the spring floods, as irrigation by flood inundation was impossible on account of the lowness and the lateness of the flood. Over large areas, the harvested grain did not even equal the seed sown. The late rains which fell in May did damage to the harvested stalks of corn.

12. In regard to summer cultivation the rice crop in the Shamiyah and 'Amarah areas was well above normal. Summer vegetables, maize and millet were adversely affected by the unusually high temperatures which prevailed. The date crop was about normal, but the excessive heat caused it to ripen prematurely, and the high temperatures caused a large number of date palms to throw out a second crop of flowers late in summer.

13. The 1921 summer was unusually hot . At Baghdad the highest maximum temperature recorded was 121·1 ° F on the 19th July, 1921. The mean maximum temperature during July was 115.8 ° F as compared with a recorded average of 109 ° F over a period of 32 years. At Basrah, the highest maximum temperature recorded was 128.9 ° F on the 17th July, and the mean maximum temperature during this month was 121.5 ° F as compared with a recorded average of 105.7 ° F. Corresponding temperatures at Mosul are given in the appended statement.

	Mean Monthly Temperature for July, 1921.		Relative Humidity Mean Monthly for July, 1921.	Highest Temperatures in 1922		Rainfall 1920-1921 season.
	Maximum.	Minimum.		Date.	Maximum.	
Basrah	121.5°	87.7°	39%	17-7-21	128.9°	3.60″
Baghdad	115.8°	85.2°	21%	19-7-21	121.1°	6.12″
Mosul	111.5°	75.3°	24%	14-7-22	117.0°	16.25″

14. The 1921-22 rainy season opened most favourably with 3·36″ in November and 1·83″ in December. Unusually large areas were in consequence put under cultivation. Subsequent rains have been most favourable, and a bumper crop is anticipated. It is tentatively estimated that there will be available for export a surplus of at least 100,000 tons of wheat and barley in the current season.

15. Meteorological Records at Baghdad :—

Month.	Mean Rainfall in Inches.		Temperature in °F.				Relative Humidity.	
			Mean Maximum.		Mean Minimum.			
	1887/1920.	1921.	1888/1920.	1921.	1888/1920.	1921.	1889/1920.	1921.
January ...	1.16	1.63	59.1	57.2	38.8	39.9	78%	84%
February ...	1.11	0.22	64.8	62.6	42.8	42.0	73%	65%
March ...	1.27	0.13	72.8	71.6	49.6	47.9	69%	50%
April ...	.92	0.21	83.2	85.3	58.4	62.0	60%	51%
May ...	.25	1.19	93.8	91.9	68.1	68.6	50%	55%
June ...	.00	0	104.2	103.8	75.8	76.7	36%	24%
July ...	0	0	109.2	115.8	79.5	85.2	37%	21%
August ...	.02	0	109.8	111.0	78.9	81.2	39%	29%
September ...	0	0	103.4	104.8	72.5	73.0	42%	25%
October ...	.08	0	92.5	91.3	63.3	63.5	51%	34%
November ...	.85	3.36	75.0	74.7	50.6	53.3	65%	60%
December ...	1.25	1.83	62.7	57.9	42.3	45.0	79%	89%
	6.91	8.57	85.9	85.6	60.0	61.5	57%	49%
	Totals.		Mean Annuals.					

III. STAFF.

16. The following statement gives a list of Gazetted British Personnel on the cadre of the Department of Agriculture during the year :—

Appointment.	Name of Incumbent.	Headquarters on 31st December, 1921.	Remarks.
Director of Agriculture.	Mr. R. Thomas, B. Sc.	Baghdad.	Appointed Director of Agriculture with retrospective effect, from 21st October, 1920.
Deputy Director of Agriculture.	Mr. G. S. Cameron, M.C.	Baghdad.	Absent on leave from 25th July, 1921 to 10th January, 1922.
Deputy Director of Research.	Mr. J. F. Webster, B. A.	Rustam Farm.	Assumed charge of Central Farm, Rustam on 7th September, 1921.
Agricultural Circle Officer.	Mr. C. Gautby, B. S. A.	Ba'quba.	Officiated as D. D. A., during absence of Mr. Cameron on leave. Absent on leave in India from 8th September, 1921 to 11th October, 1921.
Agricultural Circle Officer.	Mr. W. D. Garbutt.	Basrah.	Absent on leave in England from 23rd March, 1921 to 10th September, 1921 ; up to the time he availed of leave, he was stationed at Kut. On his return transferred to Basrah.
Agricultural Circle Officer.	Mr. R. R. Anson.	Rustam Farm.	Up to 30th April, 1921 he was stationed at Mosul. On 1st May, 1921 transferred on special duty to collect data relating to irrigation engines and pumps. Absent on one month's leave in Australia.
Agricultural Circle Officer.	Mr. C. L. White.	On special duty Baghdad.	Superintendent, Central Farm, Rustam until 24th September, 1921. He was engaged on the pump survey for the remainder of the year.
Assistant Agricultural Circle Officer.	Mr. E. A. Kinch.	Kut.	Officiated as Agricultural Circle Officer, Kut from 16th March, 1921 to 10th September, 1921 and as Agricultural Circle Officer, Baqubah, on duty at Kut, from 11th September, 1921 to 10th January, 1922.
P. A. to Director of Agriculture.	Mr. H. G. D. Rooke.	Baghdad.	Assumed executive charge of Weather Bureau in addition to his other duties.
Botanist.	Mr. L. W. Thompson.	—	Reported for duty on 8th January 1921. Relieved on 6th November, 1921 to return to India.

17. The following Non-British Gazetted Personnel were employed :—

Appointment.	Name of Incumbent.	Headquarters.	Remarks.
Assistant Botanist.	Mr. K. Sawhney, M. Sc.	Rustam.	Assumed charge of Cotton experimental work and Wheat and Barley breeding.
Assistant Chemist.	Mr. S. Tiwary, B. Sc.	Karradah.	Reported for duty on 20th February, 1921.
Assistant Entomologist.	Mr. A. Dutt, B. A., M. Sc.	Karradah.	Reported for duty on 10th March, 1921.
General Manager.	Khan Sahib A.A. Sufi, L. Ag.	Rustam.	On transfer from the Cotton Farm, Karradah, appointed General Manager, Rustam on 15th January, 1921.
District Agricultural Inspector.	Mr. Ghulam Husain.	Ba'quba.	In charge of Cotton Development Work, Diyala area and Manager, Ba'quba Farm.
Assistant Agricultural Circle Officer.	Mr. Ibrahim Assil Beg.	Baghdad.	In training under Deputy Director of Agriculture from date of appointment on 9th May, 1921 until he resigned on 15th September, 1921 to take over management of a private estate.

IV. ADMINISTRATIVE.

A. GENERAL REMARKS.

18. The year under review has been one of steady progress. The Arab Rebellion of 1920 left its aftermath, but it was possible to recover much of the lost ground early in the year. In so far as the work of the Department of Agriculture is concerned the most serious set-back occasioned by the Rebellion was the interruption to the seasonal cultivation of crops on the Central Experimental Farm situated at Rustam on the River Diyala near Baghdad. Most of the experiments in hand suffered in consequence.

19. The year will be a land-mark in the Agricultural Development of 'Iraq for the dual reason that the erection of the Agricultural College and Research Institute at Rustam was sanctioned and construction commenced; and, secondly, the cultivation of cotton on a commercial scale for export was undertaken for the first time by local cultivators.

20. The increased attention demanded by Cotton Improvement Work and the importance of the date industry necessitated a redistribution of staff and of Agricultural Circles.

21. District Work is now practically confined to the areas commanded by the Yusufiyah and Saqlawiyah canals, by those canals taking off from the River Diyala, to the riverain tract irrigated by lift in the vicinity of Baghdad and to the date zone on the Shatt-al-'Arab. The Hillah irrigated area holds out good prospects for a rapid extension of cotton cultivation, but it has been decided to concentrate the work in the above mentioned areas until such time as funds permit the programme of work to be extended. As a result, the Mosul, Kirkuk, Hillah and Nasiriyah Liwahs (or Divisions) have been neglected. We fully realise that there is much useful work to be done in these latter Divisions but it is our experience that as long as finances do not permit the necessary trained staff to be permanently stationed in these areas any form of propaganda or demonstration is unproductive and wasteful.

B. AGRICULTURAL RESEARCH.

I. General Remarks.

22. The Research work on hand suffers on account of a limited Budget which implies the minimum of staff, of accommodation, and of apparatus, but steady progress is recorded in all of the Scientific Sections. The three Sections of Botany, Chemistry,

and Entomology are confined to three small rooms each of which has a floor space of only about ten feet square. But, as evidenced by the valuable publications that have emanated from these Sections, the work that is being done is of permanent value.

23. The importance of Agricultural Research Work to the Agricultural Development of the country cannot be over-estimated. There are multifarious problems which demand solution. Many of these can only be investigated in the laboratory by suitably trained men. These men have of necessity to be specialists in their respective subjects. It is not to be expected that each and every investigation undertaken must prove to be remunerative. No research work can admit of such a condition being imposed upon it.

To the initiated, these statements are mere platitudes ; but they are recorded here for the reason that subsequent to the change in the Government of the country there has been an increasing tendency to regard as unnecessary, and wasteful of expenditure, that portion of the programme of work of the Department which does not hold out promise of immediate profit. In General, the Department continues to confine its main lines of Research work to those problems of greatest economic importance.

II. Botanical Section.

(a). Cereals.

24. During the absence of Mr. V. H. W. Dowson at Cambridge, Mr. L. W. Thompson was appointed temporarily as Agricultural Botanist to take charge of the wheat and barley breeding work. Some 163 varieties of wheat, of which about 50 were indigenous pure line selections and the remainder imported foreign varieties, were grown in single lines in quadruplicate plots. Twelve of the most promising varieties have been propagated in the current season. The experiment is being continued with both wheat and barley.

25. Large quantities of wheat seed were imported into the country from India by Military Authorities during the War and distributed amongst the cultivators. Of the seed that was distributed all trace has been lost; the imported seed did not give satisfaction as it did not compare favourably with the indigenous varieties. It had the further disadvantage of not being suited for making unleavened bread which factor was important when local consumption was the only consideration.

26. Previous to the War there was an export trade in wheat and barley from the 'Iraq varying from negligible quantities to 146,000 tons in 1912. During the War all export of cereals ceased, and export has not yet been resumed to an appreciable extent. With the bumper crop now standing it is tentatively estimated that there will be a surplus of at least 100,000 tons of wheat and barley for export in the coming season.

27. There are factors that detract considerably from the value of 'Iraq cereals on the World's markets. The wheat lacks uniformity of type; it is frequently mixed with a high percentage of barley ; and it invariably contains earth in varying degrees. 'Iraq barley is of a high grade, but its value for malting purposes is depreciated owing to its lack of uniformity of type.

28. The Research Section has in hand the breeding of pure type wheat and barley suited for the World's markets. And it is hoped in the near future to distribute seed of those varieties which give the best returns.

29. One of the chief factors that decreases the yield of wheat in 'Iraq is 'Rust' disease. Of the 50 odd selections of 'Iraq wheats under experiment none have yet been found which are conspicuously resistant to rust. Strength of straw, baking qualities, yield, and resistance to rust are the more important attributes of a wheat suited for cultivation in the country. The imported varieties under experiment are pure types from the chief wheat growing countries of the world.

(b). Tree Nursery Work.

30. The small Tree Nursery situated on a plot of land adjoining the Military Dairy Farm has served a purpose in supplying various Departments and a few local landowners with tree seedlings. The value of the work done, which was initiated

during the War, has been affected adversely owing to the absence of detail records regarding the progress of each imported variety of tree. The climatic conditions in 'Iraq are of the extreme type in that both the annual and diurnal ranges of temperature are exceptionally high. There are only a few varieties of trees that will survive both the excessive heat of Summer and the few degrees of frost normally experienced in Winter.

Of the trees grown the following varieties are well suited for cultivation :—

Lombardy Poplar	...	...	...	(Populus sinensis)
Euphrates ,,	...	...	...	(Populus spp.)
Tamarisk	...	...	...	(Tamarix articulata)
Plane Tree	...	...	...	(Platanus orientalis)
Shisham	...	...	...	(Dalbergia sissoo)
Persian Lilac	...	...	...	(Melia azederack)

A large variety of tree seeds has latterly been imported from various countries to be grown in the new Tree Nursery at Rustam. Records of the progress of each variety will be maintained.

31. Most of the time of the Assistant Botanist was taken up with Cotton Experimental Work which is separately dealt with in paras. 46-52 below.

32. A fairly representative collection of plant specimens of the 'Iraq has been made, but further work on the herbarium will be postponed owing to the greater importance of other lines of investigation.

III. Chemical Section.

33. This Section continues to confine the greater part of its studies to soil problems. Three scientific papers have been published as a result of the soil survey of the area commanded by the canals taking off from the Right Bank of the River Diyalah. The value of this soil survey has already been commented upon in the Annual Report for 1920.

34. The fact that the Assistant Chemist is working single handed in the laboratory greatly retards the progress of these soil surveys. The survey of the major irrigated areas of the country was abandoned in favour of that of the area between the Pusht-i-Kuh Hills and 'Amarah known as the Duwairij Special Project. For political reasons it was deemed expedient to bring a fairly large area in this tract under perennial irrigation from hill streams. Many lakhs of rupees had already been spent in the preliminary investigations, and in contour surveys, when this Department was called upon to express an opinion as to the suitability of the proposed area for crop production. A soil survey was initiated and the water of the hill streams also examined.

It was discovered that a very large portion of the area contained such a high percentage of salt as to render crop production unprofitable. The scheme would involve from the outset reclamation of a large area in addition to the ordinary construction of dams and canals. In addition it was discovered that the salt content of the hill streams concerned was so high as to necessitate the construction of a comprehensive drainage scheme without which even the fertile or sweet soils would be rendered saline during the first few seasons of cultivation. As a result of these investigations the projected irrigation scheme was abandoned in favour of other schemes which held out greater promise of early and better returns for the capital expenditure involved.

The abandonment of the Duwairij Special Project Scheme serves as one of many illustrations of the value of the Research Section to the Government.

35. While the soil problem was under study it transpired that most of the 'Iraq soils, on being thoroughly mixed and puddled with water, disintegrate into colloidal particles only. On applying small quantities of certain chemicals to the water it was discovered that the colloidal particles were further disintegrated to the ultimate non-colloidal particles. It was believed that the principle could with advantage be applied to brick making, and that the process might prove to be the solution to the great inferiority of modern kiln-burnt bricks to the ancient Babylonian brick.

Laboratory experiments with miniature bricks appeared to vindicate this presumption. On further experiments being conducted on a large scale in a kiln it was discovered that though the method succeeded in producing an unusually good brick, (provided very special care was taken in the moulding,) yet with ordinary moulding the improvement over the ordinary brick was not sufficient to recommend the method for use on a commercial scale.

IV. Entomological Section.

36. Numerous insect pests of crops were investigated during the year, but greater attention was given to discovering protective or remedial measures for the control of some of the pests and diseases of dates.

37. The great importance of the date crop has been emphasised in previous Reports. This subject is further dealt with in paras. 60-63 below. There are strong reasons for believing that the gross yield of the date crop in 'Iraq each year is largely determined by the incidence of various insect pests. Of these pests the following are the most destructive :—

(a) HASHAF (Batrachedra Amydraula, Meyr.)

This pest is a small pinkish caterpillar which bores into the immature fruit causing it to shrivel and fall to the ground. Of the fertilised immature dates which fall, a very large percentage become detached from the fruit stalk for purely physiological reasons ; and there is a tendency to attribute to the Hashaf worm a greater degree of destructiveness than is justifiable. No suitable control measures have yet been discovered, and the life-history of this insect continues to be investigated with the view to finding its most vulnerable stage.

(b) GHUBBAR (also known as TOZ, 'A'A', 'TARAB) Paratetranychussp,

The Date Mite.

This disease makes its appearance from July to September. It is believed to be the worst of all the diseases of dates. A fine silken web is woven over the fruit bunches. Dust carried by the wind gives the bunches a dirty appearance. The mites which are almost microscopic in size live on the fruits within the web by lacerating them. Attacked fruits are dwarfed in growth and do not reach maturity. Dusting of the fruit bunches with flowers of sulphur is believed to be a remedy provided the treatment is given immediately the disease appears, but spraying with a 10 % kerosine emulsion is cheaper and is the more likely to reach those parts inaccessible by sulphur dusting. The kerosine emulsion should be sprayed in June or July and repeated seven days later. This mite can only live under desert conditions in a dry atmosphere ; and the intensity of the attack is determined partly by the summer temperatures prevailing and partly by distance from the river towards the desert where conditions are less humid.

(c) MANN-AL-NAKHL. (The Date Fulgorid or plant louse.)

The presence of this disease is easily detected by the presence of honey-dew on the palm fronds and on the underlying vegetation. The insect responsible is a small greyish bug which hides during the day in the hollows of the leaf sheaths. There are two distinct broods during the year. The first brood hatches in April-May from eggs laid in the pinnae of the fronds in the Autumn. The second brood hatches out in September. This disease is periodic in its intensity and some 10 years ago it is reported to have caused considerable damage. The attacked palm loses its vitality for two or three years with a consequent reduction in the yield of dates. It was discovered by experiment that kerosine soap emulsion of special strength had the desired effect of killing all the bugs. Spraying should be done in May when the bugs are in the nymph or wingless stage, and again in September if necessary. Demonstrations of this remedy were made near Baghdad.

38. In addition to the routine work of collecting and mounting specimens of all insect pests of cultivated crops, special attention was given to the following pests:—

The Peach-Stem Aphis.

This is a serious pest of the peach tree. Experiments have proved that the pest can be totally destroyed by spraying with tobacco soap decoction or with kerosine emulsion of prescribed strength. Local cultivators are already adopting this method as a result of the effective demonstrations given by the Department.

The Cotton Boll-Worm. (Earias Insulana).

This is at present the only serious pest of cotton in 'Iraq. A count was made of the bolls affected with this pest in September. It was discovered that the affected bolls in different fields at this season varied from 30 °/₀ to 70 °/₀ of all the bolls then borne by the plant. Of the bollworms discovered it was found that up to 30 °/₀ had been killed by the parasitic fly. *Rhogas Kitcheneri.*

39. We are indebted to the Imperial Bureau of Entomology, London, to the Imperial Entomologist, India, and to Mr. E. E. Green for their kindness and courtesy in identifying on our behalf various insects of economic importance.

40. No organisation exists in the country to prevent the introduction of insect pests and diseases from other countries. Proposals have been submitted for the enforcement of legislative measures to control the importation of all plants and parts of plants which are susceptible to disease. These measures cannot be undertaken until arrangements can be made to purchase the necessary fumigating plant and erect a laboratory at Basrah. Financial considerations forbid this important work from being adopted at present. The very grave danger of the accidental introduction of foreign pests and diseases of wheat, barley, cotton, dates and other crops will continue until something practical can be done in this matter.

V. Agricultural Education.

41. The only form of Agricultural Education that has been undertaken up to the present, is the practical instruction of cultivators and landowners in cotton growing and in spraying of date palms to control disease. Periodic visits are arranged to the Experimental Farms, and members of the District Agricultural staff visit each privately-owned plot of cotton as frequently as circumstances will permit.

42. No form of Technical Education has yet been given other than the deputing of one 'Iraqi to Kashmir to undergo a short course of training in Sericulture; and another to the American College at Beyrout, in consultation with the Ministry of Education, preparatory for a further course of training at an Agricultural College.

43. The erection of the Agricultural College and Research Institute, projected in 1919, has at last been undertaken. The site of the College is at the Central Government Farm at Rustam on the River Diyala about 10 miles South of Baghdad and within easy reach of the Military Cantonment. The necessary tutorial staff will have to be engaged from abroad until locally trained men are suitably qualified.

44. The necessity for more technically trained subordinates on the cadre of the Department is very sorely felt. With one exception the 'Iraqi members of the staff have no technical training whatsoever. Only a few of them have mastered the rudiments of the subjects taught in elementary schools, not excluding their native language. The work which they are asked to do, involving, as it does, many hours exposure in the field daily, is of too arduous a nature to attract the better educated town dweller or landowning class. As regards the few 'Iraqi members of the staff who have proved to be eminently suited for the work which is normally delegated to college trained assistants, it frequently happens that financial regulations in force will not permit these men to be promoted to the extent desired in the best interests of the service. Coupled with this fact is the natural tendency, with the change in Government, to replace Indian technical personnel by local inhabitants. There is but little hope of attracting the right type of 'Iraqi for employment in the Department until merit can be rewarded amongst those already employed.

C. EXPERIMENTAL FARMS.

I. General Remarks.

45. Three Experimental Farms continue to be maintained. These comprise the small Farms at Kut and Ba'qubah where further trials are being made with the better varieties of wheat, barley and cotton before distributing the seed to cultivators, and the Central Farm at Rustam on the Diyala near Baghdad where the more highly technical experiments are conducted on various crops.

At Kut, a temporary breakdown of the pumping plant during the critical summer season adversely affected the experiments. Likewise at Ba'qubah, the 'perennial' canal from which the Farm is irrigated carried water at very irregular intervals. At the Central Farm, Rustam, the erection of the well on the river bank was delayed as a result of the Arab Rebellion of 1920, and the Autumn floods arrived too early to permit the work to be completed immediately after the disturbances had been quelled. As a result, the half finished well was a constant source of anxiety during the year under review. By dint of vigilant care and the use of a considerable amount of manual labour on the intake channel, the summer crops were saved from extinction, but a large area of winter cereals had to be abandoned. The partially completed ferro-concrete intake chamber and gutter proved to be unsatisfactory. The Public Works Department replaced these with a brick man hole gutter after the 1921 floods had subsided. At the same time the ferro-concrete well was completed and is now giving every satisfaction

About 800 acres of the Central Farm have been canalised and some of the main roads completed and planted up with avenue trees. About 100 acres are reserved for Research and experimental work with various crops. The remaining area is mostly utilised for propagating seed of those varieties of wheat, barley, and cotton that have proved their superiority in the experiments.

Owing to the absence of shade trees on the Rustam Estate it was decided to transfer tree nursery work to a site, about one mile downstream of the farm buildings, where a few immature palm trees give a reasonable amount of shade. Wheat and barley single-line varietal tests are also undertaken on this site.

At Kut and Ba'qubah the farm buildings are inexpensive mud huts. At Rustam most of buildings are made of mud bricks but permanent buildings of kiln burnt bricks are being erected as finances become available. There is a pressing need for more accommodation at Rustam for staff as well as for farm animals, farm produce, and machinery.

II. Cotton Experimental Work.

46. From 1918 until the end of the 1920 season the chief site of the cotton experimental work was at the Cotton Farm, Karradah, near Baghdad, where it was under the executive charge of the Cotton Expert. On the appointment of the latter as Director of Agriculture the executive charge of the cotton experiments was handed over to the Assistant Botanist ; but the main lines of study continue to be framed by the Director.

47. Had it been possible to foresee the effect of the Arab Rebellion of 1920 on the progress of work on the new site at Rustam a further effort would have been made to renew the expired lease of the Karradah Cotton Farm.

Most of the land on the Rustam Farm had been continuously cropped for many years without any form of manure being applied to replenish its fertility. The soil is extremely deficient in organic matter ; it has a high percentage of lime, and it cakes and cracks badly after irrigation. The labour employed on the Farm was casual labour recruited from various sources and it was unsuited for the work in hand. Of the subordinate staff on the Farm only two had any previous experience of experimental work with cotton, and the urgent demand of other duties prevented these from giving the cotton work their undivided attention. Coupled with these adverse factors was that of the difficulty experienced in maintaining the supply of water.

48. The net result was that we succeeded in growing a crop of cotton, but the experimental value of the work was largely vitiated. It is possible, however, to draw certain conclusions of value. These may be briefly enumerated as follows :—

(*a*) That as indicated in previous experiments, the local climatic conditions are much better suited to the cultivation of American than of Egyptian varieties.

(*b*) That under the adverse conditions of cultivation obtaining in 1921 the yield of all varieties was inordinately low and that of the Egyptian varieties was almost negligible.

(*c*) That an American variety imported from the Sudan gave the highest yield in the main varietal test. But the mixed nature of this crop and the high proportion of short staple preclude it from being propagated.

(*d*) That in the subsidiary varietal test, a 1918 selection from *Allen's Long Staple*, (temporarily named *Rustam 12*,) and further selections made from it in 1919 (*R. 47 ; R. 48 ;* and *R. 49*) topped the list of lint yields.

(*e*) In the spacing experiment there was a definite tendency for the yield to be increased with increased spacing up to the maximum spacing under experiment, of 5 feet by 4 feet.

(*f*) The results of previous experiments were confirmed in that the ridge method of cultivation gave appreciably higher yields than when sown on the flat.

(*g*) That under adverse conditions of cultivation the ginning percentage as well as the quality of all varieties of cotton is considerably depreciated; and that as the daily temperatures fall and climatic conditions are less severe in the Autumn the ginning percentage and the quality of the cotton improve.

(*h*) That preliminary investigations conducted at the Ba'qubah Farm seem to indicate that in testing different strains of cotton the recording of yield from individual lines or double lines of plants of uniform growth (and taking the plant as the unit of yield) gives more reliable results than when the plot is taken as the unit of yield.

(*i*) That the commercial sowing of cotton on ridges with inexperienced labour in those soils that cake badly is a risky undertaking; and better results can possibly be obtained by sowing with a machine drill-seeder or dibbling the seed in the plough furrow after a preliminary irrigation. The second irrigation should be withheld until the seed has germinated.

(*j*) That the more recently imported variety of cotton designated '*Hartsville*' appears to be an improvement on the *webber 49* type. Both of these selections were originally obtained from Messrs. The Pedigree Seed Company, S. Carolina, U.S.A.

49. The selection and propagation of single plants of superior type continues. The Central Farm at Rustam is the nucleus for the annual seed Supply which will be distributed to cultivators. It is only by this means that it will be possible to maintain the quality of the commercial crop.

50. The voluminous statistics that were collected in 1921 have been partly analysed, but the experiments are being repeated in the current season and the publication of detail results are being withheld until records have been obtained from experiments conducted under normal conditions.

51. Owing to the risk of admixture of types from cross fertilisation and other causes it has been decided to exclude all Egyptian and short stapled American types from further experiments.

52. The variety of cotton seed now distributed by the Department originated from the Pedigree Seed Company already referred to. The original name of this variety of cotton was Webber 49; but owing to indications apparent from the 1919 Liverpool valuations that the Mesopotamian product possessed certain distinctive merits it was decided to give the crop of cotton from this seed the commercial name of *Mesopotamian White* which was later abbreviated to *Mesowhite*. In so doing we take this opportunity of recording our indebtedness to Messrs. The Pedigree Seed Company.

III. Other Crops.

(*a*) *Flax*.

53. In experiments conducted with different varieties of flax on a very small scale in 1920, the results indicated that the local climatic conditions were well suited to flax cultivation. Enough seed to sow 40 acres was ordered from England in 1920 Owing to unavoidable delays in transit the seed did not arrive until the autumn sowing

season of 1920 had passed and the spring season of 1921 was well advanced. Altogether about 30 acres were sown with flax seed. The flax straw grew to a height of about two feet at Ba'qubah and Rustam and 3½ feet at Kut. Difficulty was experienced in retting the straw, and still greater difficulty in scutching the retted straw. The inexperienced native labour employed tore the fibre and could not succeed in effectively removing the fibre from the straw. The samples despatched for valuation to England were, for these reasons, declared to be almost valueless.

54. The crop grown at Kut in the *autumn* of 1921 averaged 3½ feet in height and part of the crop was five feet high.

55. It is confidently believed that, provided retting and scutching can be done satisfactorily, the flax crop is one that will prove to be very profitable on irrigated lands in 'Iraq when sown with the first rains in November. It is not improbable that it could be grown as an unirrigated crop in the submontane tract of the Mosul Liwah where it is already being grown for linseed. The cultivation of the crop is no more difficult than that of wheat or barley. But an organisation is required, which will be prepared to scutch the crop by machinery and possibly to ret it as well. From enquiries instituted locally, it appears that landowners are willing and ready to enter into an agreement to cultivate flax and deliver it either green or retted to the factory. Without some such organisation flax cultivation has but little chance of succeeding. There is a world shortage of flax at present, which is estimated at about 200,000 tons; and not until Russian stocks will again be available will the flax market become normal.

56. The current London quotations for flax vary from £100 to £140 per ton. An average crop of scutched flax is considered to be about ¼ ton. This is equivalent to £25 to £35 gross value per acre, retted, scutched and delivered in London. £8 per acre can be taken as a conservative estimate of the value of a good standing crop of flax—unretted and unscutched. This compares favourably with the average value of £2 to £4 per acre for local barley and wheat crops at current prices.

57. A two-berth scutching machine is being imported for further experiment with the flax crop but the commercial cultivation of the crop is a matter for private enterprise.

(*b*) *Maize.*

58. Two varieties of Maize (Flint and Dent) were received from the Department of Agriculture, Washington U.S.A. in 1921. These were grown on the Experimental Farms. Both varieties promised well at the start, but as the season advanced they were badly attacked by a maize stem borer *Sesamia cretica*. The yellow *Flint* variety suffered most, and the yield of maize was negligible. The white *Dent* variety survived the attack and some magnificent cobs were collected. This seed is being distributed in small lots to a few of the more enterprising landowners in the belief that it will be found to give better returns than the very low grade local variety of maize.

(*c*). *Groundnuts.*

59. The comparative test with different varieties of groundnuts (or monkey nuts) was continued. The results obtained on different Farms are so erratic as to preclude conclusions being drawn regarding the relative yielding capacity of any variety, though the large-pod Japanese variety appears to be on an average the heaviest yielder.

Groundnuts will grow well in the country, but it is very doubtful as to whether it will ever be possible for the local produce grown on a commercial scale to compete with unirrigated crops in other countries. It can only be grown in 'Iraq during the summer when its water demands are exceedingly high.

(*d*). *Dates.*

60. Samples of commercial varieties of dates have been despatched to the Imperial Institute, London, to discover their suitability for sugar manufacture. The reports have not yet been received.

61 Messrs. Strick, Scott and Co. have placed at the disposal of the Department, a consignment of artificial manures recommended for date palms. Experiments are being conducted in privately owned gardens near Basrah to discover the increased yield of dates that will be effected by applying these manures.

62. The Chamber of Commerce in Basrah is desirous that the Department of Agriculture should assist them in making an estimate of the date crop so as to facilitate marketing operations. They were informed that despite the importance of the date industry to the country, the Department of Agriculture could hold out no prospect of giving material assistance in the matter until additional funds could be provided in the Budget of the Department to employ the necessary staff. As previously mentioned, it is believed that the crop of dates each year is largely determined by the intensity of insect attacks; and if the staff were available to investigate this matter it is highly probable that information of real value to the trade could be collected.

63. Parts I and II of the memoir by Mr. V. H. W. Dowson on *Dates and Date Cultivation of the 'Iraq* have been received from the Press. Part III, dealing with the description of different varieties of dates and date-palms is now ready for the Press. This work, which forms a valuable contribution to our knowledge of date cultivation, has already been referred to in the Administration Report for 1920. Mr. Dowson is at present undergoing a course of study at Cambridge; and it would be a great advantage if he could be permitted to tour the date growing areas of North Africa before returning to the 'Iraq. No discrimination is at present made in the grading and packing of the best Basrah varieties of dates; and, as a result, Basrah dates are outclassed by those grown in North Africa, where very special care is taken in grading and marketing the dates in attractive cartons. Some of the North African varieties of dates are also known to be the finest in the world and suckers could profitably be imported into the 'Iraq.

D. DISTRICT WORK AND DEMONSTRATION.

I. Cotton Growing.

64. Up to the end of 1920, District work amongst the Arabs was almost entirely confined to investigating the agricultural economics of the country, and advising Government officials as well as the cultivating classes on matters agricultural. The experimental work conducted at the Cotton Farm, Baghdad, and on other Farms, with imported varieties of cotton since 1918 indicated that the cultivation of cotton for export on a commercial scale would prove to be more remunerative on some canals than any other summer crops under cultivation. In 1918 and 1919, the work was confined to the Experimental Farms.

65. In 1920 a block of 80 acres was grown on the share system by a Shaikh and his cultivators under the direct Supervision of the Department of Agriculture at Tall Dair on the Yusufiyah Canal. Up to the outbreak of political disturbances in July, an agricultural assistant was continuously in attendance on this work which received his undivided attention. Cotton cultivation was hitherto unknown to these cultivators and the work was carried out according to programme until the Assistant had to be recalled as conditions became unsettled. The crop gave an average yield of 1,250 pounds of seed cotton per acre. The cultivators received 40% of the gross value of the crop estimated on the basis of its current value of 25 pence per lb. of raw cotton delivered in Baghdad with Middling American at 15 *d.* per lb. and F. G. F. Sakel at 30*d.* per lb. (Liverpool quotations). From this crop 75,000 pounds of seed were obtained in 1920,—this being sufficient to sow about 2,000 acres. This brief summary gives the position of the cotton work at the beginning of the 1921 season.

66. Early in 1921, the year now under review, it was decided to confine the distribution of cotton seed to those four tracts which appeared to hold out the best prospects of an early increase in cotton cultivation. These tracts comprised (*a*) the Yusufiyah (*b*) the Saqlawiyah (*c*) the Diyala and (*d*) the Hillah irrigated areas. Seed was distributed to suitable centres for distribution and the district staff canvassed the cultivators for their requirements. After some weeks had been spent in canvassing the Hillah area the Agricultural Assistant was recalled, and this depot closed down on account of a decision being arrived at to discontinue the rotational supply of water in the Hillah canals early in the season in order to effect the

necessary repairs to the Hindiyah Barrage. Later in the season, the authorities concerned decided to close the Yusufiyah canal for silt clearance at the end of August. As the result of representations from this Department it was eventually agreed to leave the Yusufiyah canal open until the second week in September.

67. The history of the cotton work in 1921 is a chapter of accidents. The total area of cotton sown by cultivators and on the experimental farms was estimated at 600 acres. Of this, at least 200 acres were abandoned, after the crop had started to flower, owing to the inadequate supply of water. About 200 acres suffered from the same cause to such an extent as to yield no more than the seed sown. The remaining area gave a moderate yield. The total amount of seed-cotton delivered from the 1921 crop was 90,588 lbs.

68. There would be no justification whatsoever in concluding from these results that cotton cultivation in 'Iraq cannot be remunerative. The factor which determined the yield in practically every case was irregular supply of water. And it is of interest to note that cotton was not the only crop that suffered from this cause.

69. A conclusion that may safely and justifiably be drawn from the experiences of 1921 is that one of the prime necessities towards agricultural development in the 'Iraq is the proper control by suitably trained technical staff, of the water in those canals that have been more recently constructed. The control is at present in the hands of the District Administrative Staff as distinguished from the Department of Irrigation. On the older canals, tribal control, as at present exercised, is likely to be the most satisfactory means of water distribution. On most canals the Government continues to estimate its revenue demand on the basis of a definite share of the crop harvested Where crops fail through want of water, the cultivator is therefore not the only loser. There are strong reasons for believing that the Government will be able to increase materially its total revenues from these irrigated lands as soon as it is in a position to institute the necessary reforms which will ensure equitable rotational distribution of water in the existing canals. Until such reforms can be instituted, the cultivation of summer crops in particular will continue to be a precarious undertaking.

70. The largest block of cotton cultivated in 1921 was one of about 200 acres grown by Shaikh Ali Sulaiman, paramount Shaikh of the Dulaim tribe on the Saqlawiyah canal. The newly erected branch canal leading to his cotton area had the misfortune to be filled three times in quick succession with blown sand in July and August when temperatures were at their highest and the cotton most in need of water.

71. In spite of the failure of such a large proportion of the crop during the year under review, it is pleasing to be able to record that the cultivating classes are satisfied that, given reasonable treatment, cotton is likely to be a more remunerative crop than any summer crops now grown on a commercial scale. A signal proof of this is the fact that the demand for cotton seed in the current season 1922 exceeds the supply, and rationing of seed has to be resorted to. It is estimated that about 2,000 acres will be sown this year.

72. In response to a repeated demand from the Divisional Administrative staff, cotton seed was also distributed to cultivators in the Mosul, Arbil and Sulaimani Divisions with the view of growing cotton to meet the local demand. Considerable difficulty was experienced by the cultivators in ginning the produce, as the local hand-gin is not suited for ginning the variety of cotton distributed by the Department. The quality of samples of cotton from these tracts was superior to the bulk of the crop grown in Lower 'Iraq in 1921, but the high cost of transport and the risk of damage by locusts make the commercial cultivation of cotton in these outlying districts a doubtful proposition.

73. There are but few landowners or cultivators in 'Iraq who know the rudiments of cotton cultivation. The measures adopted by the Department to teach them how to grow the crop comprised the distribution of a leaflet in Arabic and English, which described in detail the method recommended ; and secondly, frequent inspections of the crop by the subordinate staff who gave constant advice to the growers. There were only three subordinates available for this work, and of these only one had received the necessary technical training. The strengthening of the subordinate District Staff is a matter of the greatest importance.

II. The British Cotton Growing Association.

74. The ginning factory erected by the British Cotton Growing Association at Shaikh Junaid, near Baghdad West Station, was completed early in the year ; and the 1920 crop of Government cotton was duly ginned and exported for sale in Liverpool on behalf of the 'Iraq Government. The total weight of the cotton was 37,248 lbs. It has recently been sold in Liverpool at a premium varying from 27 % to 32 % over Middling American cotton.

The 1921 crop grown by cultivators amounting to 49,359 lbs. of seed cotton was purchased by the Association at a flat rate of 3½ annas per lb. Payment was made to the growers on delivery at the ginnery. The arrangement appeared to give satisfaction to most of the cotton growers, but as the quantity of cotton to be handled increases, it will be advisable for the Association to open buying agencies in central depots.

It is of interest to note that the Association is able to buy the native cotton—a short staple '*herbaceum*' type—at prices ranging from 1 anna to 1½annas per lb. of seed cotton as compared with the flat rate of 3½ annas per lb. for the improved type grown from seed distributed by the Government. This considerable premium in the price offered for the better class of cotton has been a most important factor in popularising cotton cultivation. In addition, we owe the Association a debt of gratitude for adopting the far sighted policy of maintaining throughout the season the flat rate of 3½ annas per lb. of seed cotton in spite of the fall in cotton prices on the world's markets towards the end of the season.

Mesopotamia has already profited from the generous policy which is being adopted by the British Cotton Growing Association. With an organisation at hand which is prepared to pay its intrinsic value for the cotton grown the rapid development of the industry is assured.

It is hoped that the heavy initial expenses incurred by the Association in its endeavour to foster cotton cultivation in the country will be recovered as the area of cotton under cultivation increases.

III. Revenue Assessment of the Cotton Crop.

75. The Turkish system of Land Revenue, whereby the Government appropriates a definite share of the produce of the land, or its equivalent in cash, continues to be in vogue. In the case of the cotton crop grown from seed distributed by the Department of Agriculture, the Government agreed to give the former the option of paying the Revenue Demand as hitherto, or of paying a fixed assessment.

For various reasons this concession was not availed of by the cultivators. In the current season, owing to the heavy fall in prices of agricultural commodities in general the Government has agreed, without prejudice to future assessment of the cotton crop, to reduce the fixed assessment on cotton for the year 1922 to half of the fixed assessment demanded in 1921.

IV. Lift Irrigation by Oil Engine and Pump.

76. The irrigation of the riverain tract of the Tigris and Euphrates has been given a fairly considerable amount of attention during the year. The most common method adopted at present of lifting the river water for purposes of irrigation is that of internal combustion oil engines and centrifugal pumps. An economic survey of these pumping outfits was instituted during the year, and much information of value has been collected.

77. The development of the Agricultural resources of 'Iraq is in large measure intimately bound up with the facilities that exist for the irrigation of riverain lands by the investment of private capital. The land, the water and the necessary capital are at hand, but there are a number of factors which together handicap and retard agricultural development by lift irrigation. Of these factors the most important are (*a*) the Land Revenue Sytsem, (*b*) the inconvenience caused and extra expenditure involved on account of the inaccessibility of fuel for the oil engines, and (*c*) the absence of crops of commercial importance from the rotation as now practiced.

78. The Land Revenue System demands radical reform. On Government owned lands tenancy-at-will is the prevailing system, and cultivators will not invest capital in expensive plant without an assurance that their tenure of the land is secured for a period sufficiently long to ensure a reasonable return on the capital invested.

79. The distribution of oil depots is a matter in which the Government should interfere in the interests of agricultural development, though the organisation involved rests entirely with the suppliers of oil. The present supply of oil used in the 'Iraq is imported from a foreign country, namely Persia; and not until oil is produced in commercial quantities in 'Iraq territory, can we expect oil to be offered at cost price as a concession in the interests of agricultural development.

80. The absence of a summer crop of commercial, importance as distinguished from local importance, from the rotation of crops commonly practised by pump owners is a most noticeable feature in the agricultural economics of the country. It is firmly believed that the cotton crop will fill this need; and, further, that in the course of time cotton will be found to be the most profitable of all crops grown on a large scale by lift irrigation.

81. The question of lift irrigation is of such importance as to justify the main conclusions drawn from the Pump survey being summarised hereunder. From that portion of the survey already completed, the following conclusions may be drawn :—

1. The total number of pumps in the country at the end of 1921 was 786.

2. Pumps are to be found in greatest density within a radius of 30 miles of Baghdad on the banks of the Tigris and Diyala.

3. The *type* of engine almost invariably used is the open type, semi-Diesel, low-compression engine using kerosine (or paraffin) fuel with a centrifugal pump ; and the most popular *make* of engine is the Hornsby, which had already gained a footing before the war.

4. The size of engine in greatest demand had gradually risen from 6-8 H.P. before the war to 28-30 H. P. at the present time. The 30 H.P. engine is the maximum size which can be conveniently man-handled in starting. The self-starting adjustment supplied with the heavier engines is not popular as it frequently gets out of order in the hands of inexperienced mechanics.

5. The sole suppliers of Kerosine Oil are Messrs. Strick, Scott & Company, the Agents for the Anglo-Persian Oil Company. Kerosine is marketed in two grades known as "Palm Tree" brand and "Qalyan" brand. The *Palm Tree* brand is a high grade Oil obtainable in wooden cases, containing two tins of four gallons each, at Rs. 1-5-0 per gallon. "Qalyan" is obtainable only in bulk at the oil tanks maintained by the agents. Until recently the net cost of Qalyan to the cultivator at the oil depot was 13½ annas per gallon. The cost of transporting the oil to the pump varies from nil to 11 annas, per gallon, dependent on the distance from the depot to the pumphouse. The agents have latterly reduced the price of Qalyan to 10½ annas per gallon marketed in bulk ; and they have further agreed, as the result of representations made by the Ministry of Commerce, the Department of Agriculture, and numerous pump owners, to arrange a river transport service for delivery of Qalyan oil at various small central depots within a radius of about 30 miles of Baghdad. An effort is being made to induce pump owners to co-operate in maintaining oil depots to which oil will be delivered by the agents at concession rates.

6. The use of *Palm Tree* brand at Rs. 1/5 per gallon as fuel for irrigation engines makes profitable cultivation prohibitive. During the year numerous complaints were received from pump owners that the supply of Qalyan brand was exhausted in some of the oil depots belonging to Messrs. Strick, Scott & Company, with the result that pump owners had to resort to the more expensive Palm Tree brand. The agents are endeavouring to prevent a recurrence of this shortage.

7. The crops that form the main source of profit on pump irrigated lands are vegetables and fruit in summer, with wheat and barley in winter. During the War the prices realised for all agricultural produce was exorbitantly high. On a reduction being effected in the Army of Occupation the supply of vegetables and cereals was found to exceed the demand and prices have latterly fallen to such a degree that cultivation by pump as at present practised is a doubtful financial proposition. A reduction by the agents of three annas per gallon in the price of Qalyan oil has induced many cultivators, who had proposed to discontinue irrigation by pump during the current summer months, to reconsider the matter.

8. On investigating the fuel consumption of various types of oil engines, it was discovered that a very considerable saving could be effected in the running costs of pumping plant by using high-compression engines of the four-cycle open type, using Fuel Oil (Residual oil), instead of Qalyan. Though certain types of high compression engines imported into the country have not given satisfaction—owing, entirely, to constructional defects,—it is the concensus of opinion that the improved modern type of high compression engine using Fuel Oil is almost as easy to manipulate, and is better suited to local conditions, than the low compression Semi-Diesel engine using Kerosine oil. The main reason why landowners will not purchase the high compression engine is that the agents for Fuel oilhave only a few isolated depots where this oil is available. Provided Fuel oil is reasonably accessible to the cultivators, then it is practically certain that high compression engines using Fuel oil will gradually replace the more expensive kerosine engines. But there will be no inducement for cultivators to purchase high compression engines until the distribution of "Fuel Oil" depots is improved. This matter rests entirely with the agents for the Anglo-Persian Oil Company, who would be well advised to consider not only the suggested improvements in oil distribution, but also the question of reducing the sale price of Fuel Oil, commensurate with the recent reduction in the price of Qalyan Brand of Kerosine.

V. Sericulture.

82. In the Administration Report for 1920, reference was made to the deputation of Saiyid Ibrahim Effendi to Kashmir for a period of six months to undergo a course of training in Sericulture under Mr. M. L. Macnamara, Director of Sericulture. On arrival in Kashmir, he was put through a rigorous course of training, which included care of eggs while in storage, hatching of eggs, rearing of silk worms, treatment of cocoons and reeling of the silk. It is pleasing to be able to record that on the expiry of his course of training he was given an extraordinarily good certificate by Mr. Macnamara. He has now returned to the 'Iraq and has been placed in charge of silk demonstration work in the Diyala area with Ba'quba as his Headquarters. He is assisted by three local Arabs, who are undergoing a course of training preparatory for the extension of the work next season. One of these assistants will be deputed for duty in the Sulaimani Division, which latter tract holds out good prospects for rapid development. Apparatus for reeling the silk has been ordered from France, but has not yet arrived.

83. A further survey of the silk industry in 'Iraq reveals the fact that the industry first started in the country in 1849 when the Turkish Government is reported to have interested itself in the planting of mulberry trees. It continued to progress until 1867 when a disease of the silk worms, believed to be flacherie, killed the industry, and the "Baghdad Coccoon" disappeared from the market. In 1881 the work is reported to have been re-started by the Ottoman Public Debt Administration when schools were opened at various centres in Turkish territory. It was not until 1906 that serious attention was given to Mesopotamia in this matter. It appears that Mr. Sevien, then Director of the Ottoman Public Debt., and Mr. Anwar Khaiyat, imported ten packets of silk worm eggs with good results. This encouraged local cultivators to plant rapidly increasing numbers of mulberry trees ; and at the outbreak of the Great War in 1914 it is estimated from enquiry in the villages concerned that there were enough trees to feed about 3,500 ounce packets of eggs. This is exclusive of the demands of villages such as Mandali etc., where the

industry was also well established. During this pre-war period, eggs were imported annually from Broussa and Diyarbakr. During the war it was no longer possible to obtain these supplies of disease-free eggs, with the natural result that the local eggs became so badly diseased that silk growing was no longer profitable. Coupled with this fact was the demand of the Army of Occupation for firewood for which they were prepared to pay an exorbitant price. As the result of these two factors it transpires that mulberry trees standing in the Diyala area at present comprise barely 30% of the number to be found at the beginning of the war, and the silk industry has come to a standstill.

84. In the current year 2,000 packets of eggs were imported by a commercial firm in Baghdad. They were proferred all possible assistance in the distribution of these eggs by the Department of Agriculture. Considerable difficulty has been experienced in inducing cultivators to accept these eggs on cash payment, and it is feared that the major portion of the eggs will have to be destroyed. Should this happen, it would be most unfortunate, as there is a likelihood of the enterprising firm concerned suffering heavy financial loss, and the work will be given a serious setback at its inception.

85. In view of the suitability of local conditions to silk culture, the high prices which still obtain for raw silk, the fact that the industry has been previously established in the country, and that it is a village industry well suited to the Mohammedan population where the women can do most of the work necessary, we are strongly of the opinion that with a little assistance from the Government, the industry can develop at a rapid pace into a fairly considerable source of revenue. Incidentally, the dual useful purpose would be served if the Government could encourage the planting of mulberry trees on a large scale on all the newly constructed canals. This matter is also receiving the attention of this Department of Agriculture, and mulberry seed is being sown on a fair scale on the Experimental Farms.

86. We desire to express our gratefulness to the Government of Kashmir for placing at our disposal facilities for training Saiyid Ibrahim in Sericulture, and we owe Dr. Macnamara a debt of gratitude for the personal interest he took in Saiyid Ibrahim during the period of his deputation.

E. MISCELLANEOUS.

I. Agricultural Machinery.

87. The shortage of agricultural labour in 'Iraq has been referred to in previous reports. The demand for labour saving machinery exists, but prospective purchasers have insufficient confidence in their machines to invest capital in complicated machinery. Quite a number of landowners are prepared to contract for ploughing, harvesting, and threshing with machinery ; and a number of cases could be quoted where local firms have undertaken such contracts. It would appear that until mechanics can be properly trained and until facilities are at hand for the speedy execution of repairs at reasonable rates, then contract work by agricultural machinery is likely to develop at a faster rate than the private purchase and private use of such machinery.

88. The greatest scope for this form of enterprise is in the unirrigated steppe lands of Upper 'Iraq where wheat and barley are grown over extensive areas and where climatic and soil conditions approximate to those obtaining in the wheat belts of America and Australia (see para. 89). The form of enterprise which appears to hold out greatest prospects of success is an organisation which will possess a number of steam driven tractors with gang ploughs and seeding cultivators, combined harvesting and threshing machines, and trucks for transporting the grain to railhead. At least one central and well equipped workshop would be a necessity. Preliminary enquiries have elicited the fact that landowners are prepared to agree to such an organisation retaining a relatively high proportion of the threshed corn. The scheme may appear to be ambitious, but it is deserving of the consideration of interested parties. Very extensive areas are involved and adequate returns are assured on the share system of contract.

II. Land Development Schemes.

89. There is a rapidly increasing tendency amongst owners of large undeveloped estates to invest capital in the land. What is most needed on the large estates in the country is expert management. The most interesting development in

land schemes is that of the Mosul Farms Limited Liability Company. The Government has leased to this Company about 3,000 acres of lift irrigable land and 5,000 acres of unirrigated land at the confluence of the Lesser Zab and the Tigris, near the site of the ancient ruins of Nimrud. The Managing Director of the Company is Lt. Col. J. M. Birch, D.S.O., formerly a member of the Agricultural Directorate; and he is assisted by a qualified engineer and two assistants who live on the Estate. The Directors of the company are all natives of Mosul. The Estate is being developed with the minimum use of manual labour; and with this end in view, two steam engines complete with ploughing, harvesting and threshing tackle have been imported and have started working. The experiment is being watched with the keenest interest by the agricultural community in Upper 'Iraq. Very considerable difficulties were experienced and heavy expenditure involved in transporting the 50 tons of machinery to the Estate. Most of these difficulties are to be attributed to the unkindly treatment accorded by the Shipping Company, which undertook the transport of the machinery from Bombay. The railway authorities of 'Iraq afforded all possible assistance. It is very doubtful if any purely native enterprise would have succeeded in delivering the machinery intact in native craft some 40 miles beyond railhead on the opposite bank of the Tigris. Machinery of the type imported can only be satisfactorily worked by experienced European engineers.

90. Large areas of land in the country are owned by the Auqaf (or the Muhammedan Religious Trust). The property includes valuable fruit gardens as well as estates in varying degrees of development. Auqaf estates suffer from the same cause as Government owned land in that the maximum period of tenure, (generally three years in the case of Auqaf) is not sufficiently long to justify the investment of private capital. Auqaf lands are only one stage better than Government owned lands. An interesting departure from the usual method of leasing Auqaf Estates has recently been undertaken at Childari, near Baghdad at the instigation of the Adviser to the Ministry of Auqaf. Pumps and oil engines have been bought and erected, and are now being worked by the Ministry in co-operation with the cultivators. In return for the water supplied to him, the cultivator forfeits a share of the crop. The scheme appears to be capable of considerable extension.

III. Artesian Wells.

91. There are strong indications that artesian water exists over extensive areas in the steppe lands of Upper 'Iraq. The areas which are believed to be artesian have been mapped and defined by Messrs. Noble and Evans in their "*Notes on the Underground Water Resources of Northern Mesopotamia—Geological Report, Mesopotamia, No. 7.*" And in view of the fact that fair-sized perennial streams of water are tapped by the '*Karez*' or underground artificially-constructed channel, it would appear that fairly large areas could be brought under irrigation by boring relatively shallow artesian wells. This is a matter for commercial enterprise, and it is confidently believed that, should the first few bore holes prove satisfactory, a very large demand for boring on contract would almost immediately arise. The centre of one of the largest artesian areas is the town of Arbil.

IV. Improvement of Live Stock.

92. Nothing has yet been done by the Government to improve the quality of the live stock in the country. The Arab horse is renowned and horse breeding may be safely left in the hands of the tribal Shaikhs who can be relied upon to carry on the traditions of their race as horse breeders. Of horse management, the Arab recognises none of the fundamental principles observed in Western Countries.

93. Arab sheep may be divided into four or five distinct breeds, pure flocks of which are not infrequently maintained. The general type has a fat tail, and long wool which is inclined to be coarse. The main source of profit from flocks of sheep is their wool and it would appear *prima facie* that an infusion of Merino blood could be undertaken with considerable advantage.

94. Arab cattle are distinctively of a low grade. They are small beasts, and they do not possess the hump which is a characteristic of Indian cattle. Bullocks and cows are the chief form of animal draft utilised by the Arab: though ponies, mules, donkeys and camels are not infrequently used for ploughing.

95. During the War, a few thousand head of milch cattle were imported by the Military authorities to supply hospitals and troops with their requirements of dairy produce. Most of the cows and bulls were of the Scindi (Punjab) breed, but a few first class Ayrshire bulls were latterly also imported to produce the valuable Scindi-Ayrshire cross. On the troops being gradually evacuated from the 'Iraq, and hospitals being reduced, the Military decided to dispose of their Dairy Farms as running concerns at Baghdad, Basrah, 'Amarah, Kut and Mosul. The valuable stock, crops, and machinery were offered on very reasonable terms to the Arab Government. Minor financial objections to the transaction were raised, and this splendid opportunity of improving the stock of the country was lost. Most of these valuable animals were later converted into beef to feed the remaining troops. At Basrah a few were sold to a private company who now run a Dairy. At Baghdad part of the stock and all the machinery was purchased privately by His Majesty the King, who engages a British officer to manage the Royal Estates.

V. Agricultural Banks.

96. There are no facilities in the country for borrowing money at reasonable rates of interest on the security of landed property, live stock or crops. Landowners and cultivators who need financial assistance have recourse to the bazaar only, where the rate of interest generally varies from 10 to 20 per cent per annum though it may be considerably higher. It is the common practice to withhold from the initial payment the interest that should be due at the end of the first year ; this practice, in effect, raises the nominal rate of interest. Nearly all cultivators are heavily in debt, either to their employers or to money lenders. Agricultural Banks would go far towards assisting in the development of private estates.

VI. Economic Board.

97. Agricultural development is a matter which frequently concerns Departments other than the Department of Agriculture. And without the full co-operation of all Departments concerned, any form of development must of necessity be retarded. In the framing of departmental policies, there is occasionally a tendency to overlook the broader issues involved. It was considered that it would be an advantage if a Standing Committee could be elected, which would act in an advisory capacity in certain matters of economic importance which affect Government Departments. A proposal was therefore submitted for the constitution of a consultative body with no executive powers, known as the Economic Board, on which would be represented various Departments and Ministries. The appointment of a whole time Secretary with experience in statistics was recommended, and the Board would publish, periodically, information of commercial or of special economic value.

One informal meeting was held to consider the advisability and practicability of granting Tapu rights to small holders on the Yusufiyah Canal. The discussion served to illustrate how complex are the issues involved.

98. It appears that a Director of Statistics has been appointed with headquarters at Basrah. This appointment should be made a means of furnishing data of considerable value in arriving at a more equitable basis of revenue collection and land taxation than obtains at present.

VII. Weather Bureau.

99 The administration of the Weather Bureau was taken over by the Department of Agriculture on the 3rd January, 1921. The meteorological staff at Headquarters in Baghdad was comprised of one Indian recorder only. Temperatures were taken 4 times daily until September, after which they were taken twice daily only. Further records maintained were:—Barometric pressure, Rainfall, Windrate and direction, Sunshine, Relative Humidity, and Clouds.

Except for sunshine, similar observations were made at Basrah and Mosul by the Civil Surgeon in charge.

Rainfall records were maintained at 'Amarah, Sulaimani, 'Aqrah, Arbil, Hillah and Ramadi. Rainfall observations were discontinued at 30 stations in consequence of the Arab Revolt of 1920.

100. Towards the end of the year, the Royal Air Force decided to establish meteorological stations at various centres in the 'Iraq. Duplication of this work by the Civil Weather Bureau was considered to be unnecessary and wasteful of expenditure. The Officer Commanding, R. A. F., on being approached, very kindly agreed to place at the disposal of the Government of 'Iraq all the meteorological records maintained by his staff. As soon as negotiations are completed, it is proposed to discontinue the recording of all meteorological data, except rainfall, in outlying stations, by the Civil Administration.

VIII. Departmental Publications.

101. There is a steady accumulation of Papers, dealing with the 'Iraq, on technical agriculture and agricultural economics, which are suitable for publication. It has been proposed to publish an Agricultural Journal embodying the less technical information that is being collected; but pressure of other work has delayed the editing of the various Papers which have been prepared. The following Departmental Memoirs have issued :—

Memoir No. 1.—Alkali Lands in 'Iraq — a Preliminary Investigation, by J. F. Webster, B.A.

Memoir No. 2.—Report on the Soil Survey of the Diyala Area—Right Bank, by J. F. Webster, B.A., Dip. Agric (Cantab) and B. Viswanath. F.C.S.

Memoir No. 3.—Dates and Date Cultivation of the 'Iraq, Parts I and II, by V. H. W. Dowson.

Memoir No. 4.—Preliminary Note on the Fruits of the Diyala District, by C. Gautby.

Memoir No. 5.—Further Studies of Alkali Soils in 'Iraq, by J. F. Webster and B. Viswanath.

Memoir No. 6.—The Pests of the Date Palm in the 'Iraq, by Rao Sahib V. Ramachandra Rao, M.A., F.E.S., with Supplementary Note by A. Dutt, B.A. (Cal.) M. Sc.

Memoir No. 7.—A Preliminary list of Insect Pests of 'Iraq by Rao Sahib V. Ramachandra Rao, M.A., F.E.S.

PERSONAL.

102. What progress has been made during the year under review is to be attributed to the industry of all members of the staff. There are indications that the advice and the assistance given by the British personnel to cultivators, to the land-owning class, to that section of the commercial community interested in agricultural machinery, land development and agricultural produce, and to the officials of other Government Departments, is valued. The constant transfer and general redistribution of personnel necessitated by various officials availing of leave did not permit of continuity in the programme of work of individual officers engaged on District Work, but all worked with zeal which is commendable.

103. In the Research Section the work of Mr. J. F. Webster on various soil problems is of outstanding merit. In the course of the year he undertook charge of the Central Experimental Farm at Rustam where material progress has been made.

104. Of the non-British personnel, Mr. A. Dutt, Assistant Entomologist, Mr. K. Sawhney, Assistant Botanist in charge of cotton experiments, and Mr. S. Tiwary Assistant Chemist, maintained the high standard of efficiency which was set by their predecessors who reverted to their permanent appointments with the Government of India early in the year. Khan Sahib A. A. Sufi, General Manager at the Rustam Farm, and Mr. Ghulam Husain, District Agricultural Inspector, Ba'quba Circle, continue to be of the greatest assistance. Saiyid Ibrahim, during the course of his training in sericulture in Kashmir, made such excellent progress as to win golden opinions from the Director of Sericulture. Of the Arab District Staff, the work of 'Abdul Karim, formerly District Inspector at Kut, calls for special mention.

105. We again wish to record our appreciation of the valued assistance we continue to receive from Mr. A. Eastwood and Mr. F. Feber, the local representatives of the British Cotton Growing Association. Their sympathetic co-operation with us in our efforts to establish the cotton industry augurs well for the future.

106. This report would be incomplete without reference being made to the invaluable assistance that I have received from Mr. H. G. D. Rooke, Personal Assistant to the Director ; and it is a distinct pleasure to me to record my appreciation of his services.

ROGER THOMAS,

May, 1922. *Director of Agriculture 'Iraq.*

Administration Report of the Deputy Director of Agriculture.

A year ago I had to submit to you a Report which was pessimistic in tone. It necessarily had to be so as previous events had caused a stoppage in the continuity of work which was, and is, very necessary for the future welfare of the country.

'Iraq is primarily dependant on agriculture for its very existence. Its only exports are agricultural products, and these leave much to be desired both as regards quantity and quality. From its inception the Department of Agriculture has worked with the improvement of both in view. It continues in part to do so despite the rather severe check which it, with the whole country, received during the unsettled conditions succeeding the Rebellion of 1920. I say "in part" because it is impossible to continue developing work which was conceived at a time when schemes for the improvement of the country were probably more ambitious than the subsequent financial condition of the country has allowed.

When the Department commenced to function under the Directorship of Dr. Graham, his idea was *to build up from a skeleton Department* as its work expanded and developed. We are now endeavouring to carry on what was initiated three years ago but with half the number of personnel which was then considered the minimum. That it is a very tough endeavour few will deny. The lack of knowledge as to what is likely to happen in the future as regards retention of personnel, terms of service, budget allotment, etc. makes things more than a trifle difficult at times, and when it comes to laying down experiments or schemes for the future, one would like to have more than a hazy idea as to what that future will be.

Nevertheless the accompanying Reports show that in face of the forementioned difficulties the Staff have succeeded in re-organising, and are carrying on.

The areas are described in detail, and it is interesting to note the diverse methods of cultivation in each especially as regards irrigation. Crops in 'Iraq are irrigated by the following methods:—

1. Rainfall.
2. Tidal Flow Irrigation.
3. Gravity from high-level canals.
4. Centrifugal pumps driven by Oil Engines.
5. Single and Double Bullock Water Lifts (Cherids).
6. Persian Wheels.
7. Water Wheels.
8. Nazufa (a basket swung on ropes between two persons).
9. Kareez (Wells connected underground)
10. Artesian Wells.
11. Basin irrigation ; *i. e.* Chebis.
12. Rainfall assisted by river floods.

Roughly the modes of irrigation can be collected into three groups each particularly suited to the three main tracts of the country :—

1. The Daim tract north of the Jabal Hamrin.

2. Lift, and perennial Canal irrigation from Jabal Hamrin to Nasiriyah on the Euphrates, and 'Amarah on the Tigris.

3. The tidal irrigated area around Basrah.

The season was not a good one on account of the low rainfall in the winter of 1920-1921. Consequently the yield of winter cereals in most places was below the average. On the Diyalah canals there was a considerable loss of summer crops due to lack of water.

The date crop has been an average one, but prices have not been satisfactory.

The report on the Diyalah fruit crops is distinctly favourable.

The forecast for the winter cereal crop of 1922 is very favourable owing to early and abundant rainfall. The lowering of grain prices in the bazaar bears striking testimony to the hopeful outlook for an unusually good harvest.

District work in all the Circles consists mostly of advisory work, keeping an eye on the principal growing crops, and advising or suggesting means of improvement generally. At the same time much valuable information is collected and experience gained with regard to local conditions. The actual work has varied in different Circles as the needs of the different tracts demand.

It is but natural that the Officer in the Diyalah area should devote most of his time and attention to fruit survey and Sericulture; the Officer in the Basrah area to date cultivation, and a survey of the rice country; the Officer in Baghdad to investigate the economics of irrigation by means of oil-engines and pumps; and the Officer at Kut a study of the Marwi and Chebis cultivation of the Gharraf.

This in effect is what has taken place, Mr. Gautby has made a study of the fruits of the Diyalah District. The information collected by him, together with his conclusions has been issued as a preliminary note in form of a Departmental Memoir.

Investigation into the decline of the silk industry on the Diyalah led to Sayid Ibrahim being sent to Kashmir for a six months' course in Sericulture. He has now returned to this country and hopes are entertained that there will be a revival of this one-time flourishing industry.

The result of Mr. Dowson's enquiry into the yields of different varieties of dates has resulted in the publication of his "Dates and Date Cultivation of the 'Iraq" in two parts.

Specimens of different varieties of rice of the Shamiyah were collected during October. Mr. Garbutt has also gathered some interesting information regarding difficulties in transporting the crop.

Several proposed land development schemes have been reported upon in considerable detail, and an endeavour is being made this year to see if any material benefit will accrue from the artificial manuring of dates.

Before coming to Baghdad in the Spring, Mr. Anson obtained some very interesting information respective to the breeds of sheep in upper 'Iraq.

Mr. Kinch's notes on information collected in the Gharraf area ought to be available at an early date. He has been taken away temporarily from his own District to investigate methods of dealing with locust invasions in Mosul. Here again it is anticipated that very useful information will be procured.

Mr. White's very comprehensive report on his tour in Sulaimani is interesting. He is now engaged on the most important work of writing up data collected by him in course of his Pump Survey.

Throughout the year every endeavour has been made to present opportunities to local cultivators of witnessing methods of preparing land and handling crops by up-to-date machinery.

Comprehensive tractor trials were run at Rustum in the early part of the year. The results which have been published go to show that cultivation by the four types of tractors demonstrated is economically possible, and eminently desirable where oil supply and repair facilities are within reach. Very considerable interest was evinced in these trials, but it is a matter of disappointment that so few have taken up cultivation by this means. There is a tendency to regard the tractor with fear lest difficulty should be experienced in effecting minor repairs. Also the supply of fuel is a very considerable item in the areas where tractors would be most in demand (the Daim areas of Mosul and Erbil).

A very sore point with cultivators of the Mosul area is the fact that locally produced oil is not allowed on the market. Why this should be so is not only beyond their comprehension, but also beyond that of many others more enlightened.

Tractor ploughing demonstrations were also held in Mosul and Basrah.

Demonstrations of the use of the reaper and binder were given through the courtesy of the Manager, Military Dairy Farm, Baghdad.

Attempts have been made to introduce threshing machinery. Unfortunately these have not been attended with success as, so far, machines which have been tried are of the wooden type, and the wood-work has not withstood the terrific heat of the Mesopotamian summer. The introduction of all-steel type threshers might overcome this difficulty. This, however, necessitates further trial. Whether such a trial can be given this year or not remains to be seen. If not, it is a matter to be kept in mind for the future as the present method of threshing, and winnowing is neither efficient nor is it economical. The trial and importation of improved implements, requires the services of a whole time Officer preferably an Engineer with agricultural experience. Until a whole time Officer can be spared for this work we cannot make much headway.

COTTON IMPROVEMENT WORK.

District work on cotton improvement was undertaken for the first time during the sowing season of 1921. Little more than a beginning was made, as cultivators were obtaining such remunerative prices for winter cereals that they evinced little real enthusiasm to grow cotton. Difficulty was experienced in getting seed issued in time with the result that the majority of sowings were a trifle late.

In some instances the cultivators gave a considerable amount of care and attention to preparing their land, but the majority did not do so. As subsequent events proved, however, it made little difference to the final crop, as in almost every case, it suffered very badly for want of water. Numbers of cultivators who sowed broad-cast last year, speak of sowing on the ridge this year. It will be interesting to see how many actually do so.

Arrangements for seed distribution in 1922 are well in hand, and it is gratifying to notice the sharp demand for seed which exists. That the supply is limited, is regretted, but this may turn out to be beneficial in the long run. Seed will be issued on payment, a very necessary precaution even when the supply is abundant. The prevailing custom of advancing seed to be recovered at time of harvest does not act satisfactorily in practice.

Arrangements are being made for more frequent inspection of crops this year than formerly.

Attempts will be made to get a more accurate idea of the areas actually under cotton with a view to securing more reliable forecasts.

EXPERIMENTAL STATIONS, BAQ'UBAH AND KUT.

The following experiments were carried out at the above two stations:—

1. To discover the relative yields of different varieties of cotton.
2. To discover the relative yields of different varieties of wheat.
3. To test the suitability of an imported variety of maize to local conditions.
4. To discover the optimum date for sowing Bersim.
5. To grow four varieties of ground-nuts for seed purposes.

In addition to the above the following bulk crops were grown for seed propagation purposes:—

Ba'qubah—Wheat P. 11.

Kut—Wheat P. 11 ; Cross 3 and Jassaniyah.

Flax.

Cotton.

EXPERIMENT NO. 1.

The following varieties of cotton were used in this experiment:—

Rustum 1, Rustum 6, Hartsville, Webber 49, and Local.

The following table shows in pounds per acre the average yields obtained at both stations:—

Variety.	Kut.	Ba'qubah.
Rustum 6 (Webber)	597	952
„ 1 (Webber)	475	937
Local	196	903
Webber 49	404	883
Hartsville	460	859

The value of the experiments was seriously affected by the failure of the water supply at both stations. At Ba'qubah the shortage was worst just at the time when it was most required. At Kut the oil-engine broke down in July after which date the cotton got no more water. It is interesting to note, however, that the experiments at both stations place the varieties tested in the same sequence.

EXPERIMENT NO. 2.

Six varieties of wheat were tested:— *viz.*, Cross 3, Punjab 15, A 8, B 8, Punjab 11, and A 113. The results obtained are shown in pounds per acre in the following table :—

Variety.	Ba'qubah	Kut.
Cross 3	1,964	1,600
Punjab 15	1,924	1,480
A. 8	1,836	1,104
B. 8	1,668	1,360
Punjab 11	1,630	1,544
A. 113	1,612	1,432

Below is given a table showing the average yields in lbs. per acre obtained from tests of the above varieties in 1920 and 1921 :—

Variety.	Baghdad 1920.	Ba'qubah 1920.	Rustum 1921.	Ba'qubah 1921	Kut 1921.	Average.
P 15. ...	1,304	1,320	1,150	1,924	1,480	1,452
A. 113. ...	1,112	1,025	852	1,612	1,432	1,291
A. 8. ...	1,496	1,330	1,110	1,836	1,104	1,273
B. 8. ...	1,084	1,370	579	1,668	1,360	1,267
Cross 3. ...	1,312	1,380	1,114	1,964	1,600	1,521
P. 11. ...	—	—	1,006	1,630	1,544	1,431

If we accept the above average yields per acre the varieties come out in the following sequence:—

Cross 3 with an average of	1,521	pounds per acre.
P. 15 ,, ,, ,, ...	1,452	,,
P. 11 ,, ,, ,, ...	1,431	,,
A. 113 ,, ,, ,, ...	1,291	,,
A. 8 ,, ,, ,, ...	1,273	,,
B. 8 ,, ,, ,, ...	1,267	,,

EXPERIMENT NO. 3.

Maize :—Variety U.S.A. selection 77 from U.S.A. Department of Agriculture.

Ba'qubah.

Date of sowing.	Growth.	Remarks.
14-8-21	Growth and germination Good.	Badly attacked by maize stem borer.

Kut.

Maize :—Variety Flint 193 from U.S.A. Department of Agriculture.

Date of sowing.	Growth.	Remarks.
30-7-21	Growth good, average for each week 6" till plants attained a height of 5". $10\frac{1}{2}'$.	Yield poor on account of attack of stem borer.

EXPERIMENT NO. 4.

Ba'qubah.

Date of sowing.	Green fodder cut 30-3-21	Harvested 15-6-21	Straw.
20-10-20	13,766 lbs. per acre.	56. 5 lbs. per acre.	1,420 lbs. per acre.
30-10-20	14,144 ,, ,,	68. 0 ,, ,,	1,380 ,, ,,
9-11-20	9,864 ,, ,,	78. 0 ,, ,,	1,200 ,, ,,
19-11-20	—	54. 4 ,, ,,	296 ,, ,,

From the above table it would appear that October would be the best time to sow this crop if required for green fodder. These figures, however, only apply to 1920. The optimum sowing date will probably vary according to whether the summer is late or the winter early.

EXPERIMENT NO. 5.

The following list shows the varieties of ground-nuts which were grown and the resultant yield in pounds per acre :—

	Kut.	Ba'qubah.
Japanese large	1,200	600
Virginia	1,200	600
Madras	1,080	240
Japanese small	640	840

BULK CROPS.

PUNJAB 11 WHEAT.

One ton grown on share system with local cultivator. One ton seed yielded $15\frac{1}{4}$ tons. One-third of this went to revenue, and one-third to the cultivator, the remaining third was sent to the Government Experimental Farm at Rustum.

Punjab 11, Cross 3, and Jassiniyah wheats were grown in bulk at Kut.

Flax grown at Kut yielded 1,440 pounds seed and 280 lbs. fibre.

Cotton grown in bulk at Kut had to be abandoned owing to break-down of the Farm Oil-Engine.

STAFF.

Mr. Anson was transferred from Mosul to Baghdad in April, and to Rustum on 1st September. He was Superintendent, Rustum, until 15th December, 1921 when he proceeded to Australia on leave.

Mr. C. L. White was admitted to hospital on 1st September and discharged on 7th September from which date he did duty in the office of Deputy Director of Agriculture as well as Cotton Inspection, and subsequently his tour in the Sulaimani District. He continued work on the Pump Survey and is now completing his report on same.

Mr Gautby was appointed Offg. Deputy Director of Agriculture from 23rd July to 7th September, 1921; and from 11th October to 19th January, 1922.

Mr. Garbutt proceeded on leave in March 1921 and returned in September when he opened the Basrah Circle as from September 16th, 1921.

Mr. Kinch was made Offg. Agricultural Circle Officer, Kut, from 16th March, 1921 until 17th September, 1921, when Kut was made a Sub-Circle of Baghdad.

Mr. G. S. Cameron availed of leave to United Kingdom from 23rd July, 1921 to 6th January, 1922.

I particularly wish to thank the followiug subordinate Staff for the way in which they have worked throughout the year :—

Mr. R. D. Menon.
Mr. Ghulam Hussain.
Mr. Avedis Boydjian.
Mr. Abdul Karim.
Mr. R. J. Mendonce.
Mr. C. P. G. Nair.
Mr. F. George.

G. S. CAMERON,
Deputy Director of Agriculture,
Baghdad.

Administration Report of the Deputy Director of Agriculture (Research) for the year 1921.

I. RESEARCH SECTION.

A. STAFF.

At the commencement of the year the staff of the Research Section of the Agricultural Directorate was very reduced owing to the departure of three of the Scientific Assistants at the termination of their contract.

The staff actually stood as follows :—

Deputy Director of Research.

Vacant.

Agricultural Chemist and Officiating Deputy Director of Research.

Mr. J. F. Webster, B. A., Dip. Agric. (Cantab.)

Assistant Chemist.

Vacant.

Assistant Entomologist.

Vacant.

Assistant Botanist.

Mr. H. P. Paranjpye, B. A.

Assistant Mycologist.

Vacant.

Advertisements for suitable candidates had already been placed in the Indian papers with a view to securing suitable men for these vacant posts and through the kindness of the Agricultural Adviser to the Government of India applicants had been interviewed and selections made.

Mr. Tiwary, B. Sc., reported at Baghdad for duty as Assistant Chemist on March 1st, 1921. Mr. Dutt, M. Sc., reported for duty as Assistant Entomologist on the 20th of the same month, and Mr. Sawhney, M. Sc., reported for duty as Assistant Botanist on the same date, Mr. H. P. Paranjpye having vacated the post on termination of contract on the 10th of February. No Assistant Mycologist was engaged during the year but a Botanist, Mr. L. W. Thompson, reported for duty on the 6th of January, 1921. Mr. Thompson returned to India on the 6th November, 1921.

B. OFFICE STAFF.

Mr. Mukand Lal was in charge of the office as Head Clerk throughout the year until the 1st of November when he left for India for repatriation on termination of contract. Mr. P. Peters was typist until the 9th of October when he left to take up the duty of officiating Head Clerk at Rustum Central Experimental Farm, but returned to the Karradah Office as Officiating Head Clerk on the 4th of November. Mr. Ezer Sadqa reported for duty as Records Clerk on the 19th February, 1921, in which post he continued throughout the year.

C. LABORATORIES.

Work has continued throughout the year in the temporary laboratories located in a billet at Karradah. The accommodation is scanty, and facilities for work very imperfect. The accumulation of material, apparatus, and literature, has caused serious congestion and lack of working space. When work was started in these rooms it was expected that they would be in use for a comparatively short time only, but owing to unavoidable causes the erection of an Institute with suitable accommodation has been delayed.

D. APPARATUS AND CHEMICALS.

These have been confined to the barest necessities, since neither accommodation nor suitability of the present laboratories justify expenditure on valuable apparatus. When properly designed laboratories are available a good deal of supplementary apparatus will be needed. Stocks have been made up from time to time as necessary by indents on Indian Firms.

E. BOOKS AND LITERATURE.

These are increasing rapidly and a fair library is now available on all agricultural Sciences. The need for housing, systematic recording, and card indexing of the various periodicals is becoming acute.

At present the books are in the charge of the various Assistants who are most con cerned with their respective contents.

F. BOTANICAL SECTION.

1. Wheats and Barleys.

On the arrival of the Botanist, Mr. Thompson, he proceeded to the Central Farm at Rustum and took over the experimental wheats, which had been sown by Mr. Ghate under the direct charge of the Officiating Deputy Director (Research). About 150 varieties of wheat were tested, of which about 100 were pure line local varieties. The varietal test was conducted in single lines in quadruplicate and a number of English, Indian and Australian wheats were included in the test.

The year was one remarkably free from all diseases of cereals, and as was to be expected under such conditions the pure type selections from local varieties did better than foreign varieties. The wheats were carefully studied during growth and their botanical characteristics noted. The unavoidable lateness of sowing was perhaps responsible for the fact that imported varieties did not give higher yields.

The plants were all uprooted at harvest time and the tillers were counted and the straw strength estimated. The twelve most promising varieties were selected for further propagation in 1/20 acre plots.

Very complete records of the 1920-21 experiments exist and specimens of grain in ear were kept for purposes of comparison. In October the experiment, with some additional varieties included was again started on the open land near the new tree nursery. Earlier sowings were made and the experiment should give more valuable results than last year's.

The Botanist also made single line tests of a number of local and foreign barleys, the former of which were isolated from locally grown mixtures by Mr. Ghate. Owing to the unavoidable lateness of sowing the results from these were not valuable, but the experiment was repeated in November of this year and the lines at the present look promising.

2. Tree Nursery Work.

At the beginning of the year the only nursery work which could be done was in the open near the only working pump. Every effort was made to provide shade for the seedling trees by growing shade plants such as Castor around them, but the failure of water in the Summer had a disastrous effect.

Seedlings of *Robinia pseudacacia*, *Acacia arabica*, *Melia azedarack* (Persian Lilac) and *Pinus longifolia* survived however. These will be transplanted in 1922. A great many rooted seedlings of Persian Lilac, Bombax, Albizzia, Shisham, Willows, Poplars, Eucalyptus and Mulberries were transplanted on the Rustam Farm under the supervision of the Botanist, and remained in his charge until the Autumn, when they were handed over to the Farm Staff. In October it was decided to move the Tree Nursery to a more suitable site. Accordingly a piece of land downstream of the main Farm was chosen, since it had growing upon it a number of young date palms which would afford a fair shelter.

A $6\frac{1}{2}$ H. P. Blackstone Engine was erected here with a 4″ pump, and the land was recanalised and laid out for more extensive Tree Nursery work than had been possible on the old exposed site.

Mr. Fernandez was appointed to assist Mr. Ghate particularly in the Tree Nursery work.

The seedings from the old tree nursery site will be either transplanted on to Estate roads in the coming year or transferred to this new site, according to their size and condition. As a result of this year's work on the conditions under which trees may be grown in 'Iraq we may briefly put forward the following points:—

(*a*). A certain number of trees are capable of a very high resistance both to the extremely hot winds of Summer and the low temperatures of Winter.

Amongst these may be cited, Dates, Poplars, Willows, Mulberries, Persian Lilacs, *Pinus, longifolia*, Shisham, and some varieties of Eucalyptus particularly *Eucalyptus rostrata*.

These trees may be planted out, and provided reasonable care in planting and subsequent irrigation is exercised, they will do well. Eucalyptus of all varieties is, however, somewhat intolerant of transplantation.

(*b*). Many other trees are strong and quick growers throughout the Summer but are liable to be adversely affected by frosts. Amongst these may be particularly noted Bombax, some varieties of Eucalyptus, and Albizzia.

(*c*). Almost any tree will grow provided it is protected from the sun by overhead shade and from hot winds and frosts by lateral protection of other trees or of other members of the same species.

(*d*). Very great care is needed, particularly in Irrigation, in order to harden off trees for the oncoming of Winter. Trees tend to remain in full and succulent growth right through the year, with the result that the sudden frosts to which this country is liable do far more damage than the actual fall of temperature would seem to warrant. Every effort should be made to check this free growth, and this is best done by keeping trees short of water in the Autumn.

3. Cotton Work.

This was throughout the year under the direct supervision of the Director of Agriculture.

The Assistant Botanist Mr. K. Sawhney, M. Sc., was sent down to Rustam on the 14th of April at the request of the Director to take charge of the cotton experiments already started there. Throughout the rest of the year he continued in this work.

4. Routine

In addition to these duties Mr. Sawhney has given valuable assistance to the work of the Research Section by the various identifications he has made and the general botanical information which he has been able to afford. His own report will be found on another page.

G. CHEMICAL SECTION.

1. General.

At the beginning of the year the Agricultural Chemist was single handed in the laboratory and had in addition to perform the duties of the Deputy Director (Research). The work done in the laboratories could not be continuous under these circumstances and suffered accordingly. The two papers *Alkali Lands in 'Iraq* and *A Soil Survey of the Diyala Area (Right Bank)*, were prepared for the press and published copies were eventually received from India. Work on the further study of the alkalinity problem was continued, many determinations were repeated, and further series of pot culture tests carried out. As a result of these investigations a third paper *Further Studies on Alkalinity in 'Iraq* was prepared, and is now in the press. This paper is particularly concerned with alkalinity problems as they are affected by the physical aspect of the soils under experiment. The importance of the waterholding capacity of the soil in relation to alkalinity is emphasized, and it is shown that all improvement of alkali soils, as distinct from reclamation, must take account of these physical factors.

A considerable amount of work was also carried out on the brick making problem. It was believed that a good deal of the non-success of brick production in this country was directly traceable to the physical condition of the clay particles. Experiments on a small scale confirmed this and these experiments were repeated in the Military Brick kilns at Bab-al-Wustani. A certain amount of success followed these experiments, but subsequent work showed that though the method was satisfactory in producing a really good brick under painstaking conditions, yet the improvement of the ordinary brick as made by local contractors was too small to justify the use of the method.

2. Soil Survey.

In March the Officiating Deputy Director went down to 'Amarah for the purpose of inspecting the area to the North and East of that town which was at that time being surveyed by the Special Project party of the Directorate of Irrigation. The whole area was systematically inspected with Captain Glass, at that time Officer-in-Charge of Special Projects. The Assistant Chemist, Mr. Tiwary had by this time reported for duty and he was brought down from Baghdad, and left in Amarah to take the necessary soil and water samples. This work occupied his whole time for six weeks and on his return to the Karradah Laboratories he at once commenced work on these. As a result of his analyses of the water soluble contents of the soils and the waters, an interim report was prepared showing that the contemplated project would be to a very large extent one of reclamation as well as construction.

A large proportion of the Tigris waters are taken off at 'Amarah by the Chahalah and the Masharah canals. These canals afford irrigation to a comparatively small strip of high lying lands along their banks by flood inundation when the river is high, and by lift when the level falls. The great bulk of their waters is, however, spilt into marshes in their lower reaches.

In addition a number of streams flow down from the Persian hills and coming to the ridge formation of the above named canals spill their waters into the marshy depression. This water in the flood season reaches almost to the more Northerly canal.

A good deal of the water finds its way back to the Tigris lower reaches, but throughout the Summer thousands of acres of free water surface are exposed to the evaporating action of sun and wind. As a result, salt content has accumulated and the more Northerly marshes fed by the Persian Rivers are very saline, whilst the Tigris fed marshes to the South are slightly better. The strips of high lands that are at present cultivated are almost the only sweet lands available, and in addition to this it is probable that even though the Persian river waters were confined in a canal bed, they would in themselves be too saline to be used as a source of irrigation water in the Summer season. As a result of the interim report embodying the above conclusions the projected works in this district were given up in favour of others of more immediate promise.

3. Routine.

A considerable number of analyses and examinations were made during the year for various departments.

On the arrival of a Kew Pattern Screen for Meteorological instruments from England it was erected as a temporary measure on the roof of the laboratory at Karradah, this being the only place then available. Records were taken continuously from August to mid December. At the latter time during a very violent storm the screen was knocked over, and it was then decided to re-erect it at its permanent site on the experimental Farm at Rustam.

H. ENTOMOLOGICAL SECTION.

1. General.

This section was left rather in the air by the sudden illness of Rao Saheb Y. Ramachandra Rao M. A., F. E. S., in November 1920. On his partial recovery he was orderd home to India by the Medical Authorities and was able only to pay a brief visit to his laboratory before embarking. He tried hard to hand over his work in a finished state but was compelled to take with him a great deal of his specimens and manuscript.

As a result Mr. Dutt, M. Sc., on his taking over in March of the current year was rather in the dark as to what had been already done. He carried on as he thought best until the arrival of his predecessor' s completed manuscripts.

Since then the Section has been constantly benefited by the arrival from time to time of notes by Rao Saheb Y. Ramachandra Rao and of insects collected by him and identified by various authorities. Our thanks for this work of identification are particularly due to the Imperial Bureau of Entomology, to the Imperial Entomologist, Pusa, India, and to Mr. E. E. Green.

As a result of their work on Rao Saheb's collections we now have a collection of over one hundred named different species of pests. Further identifications are still expected and a number of serially listed pests remain to be sent.

2. Investigations.

The Assistant Entomologist has worked during the current year more particularly on the *Mann* the *Hashaf* and the *Ghubbar* or *Toz* diseases, all of these being caused to the date tree by various insect pests.

In the case of the *Ghubbar* or *Toz* disease he has worked out a very efficient remedy and in the case of *Mann* disease he has at any rate suggested a very efficient check.

The case of *Hashaf* disease is somewhat peculiar. This is the falling off of immature dates. It occurs in all seasons with greater or less severity and in many cases is doubtless merely a physiological phenomenon due to overcrowding. Previous workers have associated the "*Hashaf*" dates with the *Gelechid* larva which is found in a large percentage of the fallen dried-up dates. This year the disease was more carefully studied than has been previously possible, and it was found that, though a large percentage of the fallen dates contained the *Gelechid* larva, still the whole of the fall could be explained on a phisiological basis, regarding the insect merely as a parasite of dates already so weakened from other causes that their falling off was a foregone conclusion.

The season, however, was one of slight incidence of the disease and further work is necessitated before definite conclusions can be reached.

Numerous other insect pests were investigated during the year by the Assistant Entomologist ; these will be found enumerated in his report.

3. Demonstrations.

A very large population of insect pests exists on all of which the cultivator looks with a helpless apathy that is almost pathetic. A large amount of work looms before this Section in first of all persuading the cultivator that such diseases are susceptible to treatment, secondly in teaching him, that such treatment is remunerative, and thirdly in teaching him to apply the remedies himself. This year a start has been made in a small way, distinctive from the efforts of other years only in the attempt made to reach a larger section of the Agricultural community. The work, however, is entirely beyond the unaided efforts of one man, and more particularly so when that man is already employed in the preliminary work of investigation and experiment, and in the ordinary routine work of the Section. It is probable that the work will be one of very slow growth, and the propaganda will be only by results achieved.

A hand circular was prepared during the year on *Spraying of Fruit Trees for Greater Crop Production* and this is being circulated in both English and Arabic. It is hoped to undertake a certain amount of spraying on a payment basis during the coming year, though the efforts of the section will be towards inducing growers to do this for themselves, rather than towards an increase of work along these lines.

The climate lends itself fairly well to control of insect pests by remedial measures, as the cold Winter provides one natural check to insect activity, whilst a great many other pests are compelled to aestivate during the hot summer. Thus the breeding seasons are very limited and effective spraying during these seasons produce quick and lasting results.

(I). MYCOLOGICAL SECTION.

No mycologist was appointed to succeed the one lent on deputation from the Government of India. The preliminary work has been done and the results are on record, but, until such time as more pressing agricultural problems are dealt with, it has been judged wise in the interests of economy to suspend most of our activities in this section.

(J). FIELD EXPERIMENTAL WORK.

Until September of the current year when the Deputy Director (Research) took over Administrative charge of Rustam Experimental Farm, opportunities for field experimental work were of necessity limited.

The Botanist and his Assistant, Mr. Ghate, who was a member of the Farm Staff, lived out on the Farm taking their requirements of labour and water direct from the Superintendent of the Farm. Neither labour nor water were constantly available and the work suffered in consequence.

The Deputy Director (Research) laid down two field experiments on Smut Resistance, and on the value of preliminary soaking of seeds in nutrient solutions before sowing. Both these experiments were carried through more or less successfully. The Smut Resistance experiment was designed to show the effect of various treatments of the seed as a protective measure against "Smut". There was little incidence of Smut on either treated or untreated seed, so that the experiment gave a negative result.

The Nutrient Test was designed to show the value, if any, of soaking seed before sowing in a nutrient solution. The experiment was conducted with both wheat and barley. At the time it was laid down the only land that could be watered was a patch that had been previously under vegetables for a great many years. The land was consequently very uneven and the experimental error very high. This experimental error obviated the value of the slightly positive result in yield of grain obtained on treated plots, and repetition under better conditions has been arranged in the present season.

II. CENTRAL EXPERIMENTAL FARM, RUSTAM.

A. ADMINISTRATION.

In September of the year under report it was decided that the administration of the Central Experimental Farm at Rustam should pass over to the Deputy Director of Agriculture (Research). This arrangement was decided at a meeting of the Director of Agriculture, Officiating Deputy Director of Agriculture and the Officiating Deputy Director of Agriculture (Research), which had been called originally to discuss the desirability of Research Area only going over to the administration of Research Section.

B. LABOUR.

At the time of the change Mr. Anson was in charge as Superintendent having relieved Mr. C. L. White only a few days previously. It was the commencement of the Agricultural year and Khan Sahib A. A. Sufi, the General Manager, was at once sent out to recruit labour.

The labour up to this stage had been of the coolie type, the activities of the Farm having commenced too late in the previous Agricultural year to allow of recruiting the true *fallah*. This year we were able to obtain a better class of men owing to our demand coming at the proper season. The old "Tindal" system was abolished and the labourers put into gangs of six, each gang having its working head-man. Since arrival of this type of labour work has been much easier and more efficient on the Farm.

C. RESEARCH AREA.

This is the area set aside for experimental work. Water only became available on this area late in March of the year under report, and as a consequence experimental work was up to then distributed over the Farm wherever water was available. The first experiments put down on this area were the main cotton experiments of the season. These were as follows :—

1. Main Varietal Test.
2. Spacings Test.
3. Cultivation Test.
4. Irrigation Test.
5. Single Line Varietal Test.
6. Bulk Propagation of Selections.

In addition, a block of 20 acres on Research Area was put down to propagation of the variety *Harlsville*.

The full report of this work will be found on another page. The cottons were late sown in a poor tilth, and, standing alone, the experiments are not of great value, but taken in conjunction with the experiments of previous years the value is greatly enhanced. The most interesting feature was the results obtained from the spacings test The soil was so low in its water retention power that very much wider spacing than the normal optimum gave the best results.

A further nteresting result was given by the cultivation test. In this three methods of cultivation are compared.

1. On the ridge throughout.
2. On the flat subsequently ridged.
3. On the flat throughout.

This experiment showed marked superiority of methods 1 and 2 over 3, and approximate equality between methods 1 and 2.

Besides the Cotton experiments the following work was also carried out on this area.

Two varieties of Maize were sown for propagation in 3/40 acre plots. Both were very badly attacked by the Maize stemborer, as is usually the case with imported varieties *Flint 193* was particularly badly attacked but *Dent 77* gave a promising return.

Four varieties of Lucerne were also sown in single lines for seed propagation. These were sown late and did not flower during the year. Seed will be collected in the coming year.

In September, before doing any further experimental work, it was decided to re-adjust the lay-out and canalisation of the Area since this was neither suitable nor uniform throughout. The area was divided into five main blocks of uniform size, shape and canalisation. Each of these blocks again divided into 4 sub-blocks. The total area is 100 acres, and each sub-block gives 60 uniform 1/20 acre plots, a total of 240 plots per block, or 1,200 over the entire area.

On this newly laid-out area bersim (*Egyptian Clover*) was at once sown in one block as a green manure for next year's cotton experimental work, and one half of a second block was put down to the coming season's wheat experiments. These latter were sown in November and December and comprise the following :—

1. Main Varietal Test.
2. Nutrient Solution Test.
3. Irrigation Test.
4. Value of preliminary cultivation and after tillage test.

These experiments were all promising well at the close of the year under report.

It is highly essential that some measure of plot variation should be made on these blocks. Plot registers have been made and are being kept, and these will in time throw light on this subject. This year one complete block in the Research area has been put down to wheat with the idea of standardising all the plots with a view to conducting a permanent green manurial test.

D. ESTATE AREA.

This area is intended for seed propagation work on a fairly large scale. At the beginning of the year under report only a very small portion of it was under irrigation, and in this area were concentrated by necessity most of the crops of the Farm.

The following experiments were performed :—

1. The Nutrient Solution Test for wheats and barleys.
2. "Smut" Control Test.
3. Varietal Test of Ground-nuts.

Three varieties of Ground-nuts were tested for yield. The nuts were sown in May and harvested in November. The highest yield was from the variety known as "Large Japanese" which gave a return of over 1¼ tons of nuts per acre.

The real function of the Estate Area is, however, the propagation of crops for seed purposes. In late 1920 and the early part of the year under report about 120 acres of wheat had been sown with the winter rains, in the hope that irrigation facilities would be forthcoming in time. This hope was not fulfilled, and only 75 acres could be saved for harvest, and these suffered so badly from drought that the yield averaged only 500 lbs. per acre. Thirty acres of barley were sown also. Owing to lack of irrigation facilities and shortage of fodder, this was fed to stock,

In March the prospects of getting a supply of irrigation water seemed much more hopeful, so preparations were made for putting in about 200 acres of cotton. The land which had been ploughed by the tractors during the tractor trials (a full report of which was published by the Deputy Director of Agriculture) was ridged and prepared, and actually 144 acres of Mesowhite and 32 acres of Hartsville cotton were sown. These were always difficult to irrigate due to the hurried canalisation, and difficulties experienced in litting water. The crops did not do as well as they should have done.

In September when the main well was about to be closed for repairs it was realised that the old system of canals would have to be abandoned for the coming season's crops. Arrangements were therefore made to re-canalise the entire area which was to carry the main wheat crops. This was done and before the well was again opened in mid November the land was canalised and laid out for wheat sowings. Two hundred acres of bulk wheats were sown before the end of the year in this newly laid out land. Work was also undertaken to get ready a further block of 100 acres for the coming cotton season. Owing to lack of water, due to the main well being closed, this could not be put under a green manure crop as had been hoped, but the canalisation and lay-out were well in hand before the close of the year.

E. FARMYARD.

Up to almost the close of the year under report all the activities of the Farm were classed either as Research or Estate. With the gradual extension of the work, however, it became apparent that a great deal of work had to be done which could be properly classed under neither of these heads. A new section was therefore created at the end of the year to be known as Yard Department. This takes charge of the stables, Dairies, General Stores, Gardens, and further, of all work of general improvement such as Tree planting, Road making, Care of major Canals, etc.

F. BUILDINGS.

In addition to the temporary mud buildings on the Farm the following buildings were erected by the Public Works Department during the year under report, and handed over in the late Autumn:—

(*a*). General Manager's Bungalow.
(*b*). Clerks' Quarters.
(*c*). Workshop.
(*d*). Tractor Shed.

These have proved a great help in solving the problem of accommodation for stores, animals, and personnel At the present moment the most urgent needs are permanent stables and cow-sheds. and good cement floored store houses and granaries.

The foundations of the proposed Agricultural Institute were commenced by the Public Works Department during the late Autumn. Little progress has been made, however, due to lack of material.

The Public Works Department also undertook the putting in order of the main well. This had been caught by the rising river in the early part of the year whilst still incomplete, and had been a constant source of anxiety and trouble throughout the year. Public Works Department constructed a brick cement culvert for water to pass from the river to the well, finished off the latter, and filled in the unsightly sump which had previously been the source of inlet. This work was finished by mid November, and since then the well has given satisfaction.

G. MACHINERY.

All the pumps and engines have worked well throughout the year with the exception of the Clayton and Shuttleworth. The Keighley Imperial also gave a certain amount of trouble, owing to heating up of the brasses, and, further, to a breakage of the water jacket at a very critical time.

The motor transport of the Farm consists of a 30 cwt. Albion Lorry and a ford Vanette. The former gives good service, but the latter is now very old and worn, and is frequently out of order.

During the year a Fordson and an Austin Tractor have been bought. The former was obtained in May and has since put in useful and consistent work. The latter came only in September last. At first it was troublesome due to the unsuitability of the "Spud" grip; these were replaced by angle-iron grips and since then the tractor has given satisfaction.

All machinery has been under the charge of the Foreman Mechanic Bhan Singh, and his staff of local assistants. It is pleasing to note the rapidity with which these latter learn the proper use and handling of the machines under their charge.

H. MISCELLANEOUS.

A full account of the activities of the Farm will be found in the report of the General Manager. The most essential need at present is that of a general green manuring. The soil throughout is deficient in organic matter, and is therefore non-retentive of moisture, and cracks badly on drying. These factors militate against successful work either on Research or Estate Areas. A rotation has been laid down which allows for a green manure crop after each main crop. Until information as to the relative values of such crops as might be used for this purpose is forthcoming, the following are being used :—

Bersim as an Autumn sown crop.

Hurleman a local grown as a Spring sown crop.

Lubyah a local coarse kidney bean, as a Summer sown crop.

All these are known by experience to give good results. A full rotation of the Farm on this system should greatly improve the position of affairs.

III. CONCLUSION.

The laboratories at Karradah have been under the Administration of the undersigned throughout the year. The Assistant Chemist and the Assistant Entomologist have worked there since their arrival in the Spring and I wish to place on record the appreciation I have for the valuable work done by them under such adverse circumstances.

The Central Experimental Farm at Rustam came under my charge only in September last, and any merit that can be claimed for the year's work is due chiefly to the previous administration and to the late Superintendent Mr. C. L. White.

The staff came over practically unchanged, however, and it is my duty to record the very valuable and loyal service rendered by them under conditions which have frequently amounted to hardship in the past, and still remain none too easy.

The work of Mr. Anson as Superintendent particulary calls for notice.

Khan Sahib A. A. Sufi has occupied the position of General Manager since January last. I would bring to your notice the extraordinarily good work and unceasing devotion to duty of this official.

Mr. P. Peters in his capacity as Head Clerk, formerly at Rustam, and latterly in the Karradah Office, has rendered valuable and very efficient service.

Without the assistance of these two latter officials I should have found it impossible to have carried on the work at the Farm without a Superintendent as I have done during the latter period of the year.

J. F. WEBSTER,

Karradah, February 18th, 1922. *Officiating Deputy Director of Agriculture (Research).*

Administration Report of Agricultural Officer, Baghdad Circle.

What is known as the Baghdad Circle was formed as recently as 1st May, 1921. Previous to this, the country in the immediate vicinity of Baghdad had been attended to from Headquarters.

Early in 1921 it was realized that an officer was required for this area alone, for which reason the Agricultural Officer was recalled from Mosul in order to take up his Headquarters at Baghdad with a view to his being in close contact with the work of cotton development.

The Circle now includes the Dulaim and Hillah Liwahs on the Euphrates, as well as the Mosul, and Baghdad Liwahs on the Tigris covering a distance of approximately 400 miles on both rivers. The question of transport makes it a difficult matter to keep in touch with outlying Districts which can therefore only receive occasional visits when specially called for.

Practically the whole of the Mosul area is devoted to Daim cultivation., *i. e.*, winter cultivation of barley and wheat depending on rainfall. In the Arbil area of the Mosul Liwah occurs what is known as "Karez" irrigation ; a karez being a series of wells connected by underground tunnels leading into a final well from which the collected water issues.

The lift irrigated areas of the Baghdad Circle consist of both banks of the Tigris and the Euphrates. From the latter, however, a number of canals take off on both banks. These canals command a very considerable area commencing from Ramadi to the Hindiyah Barrage. The most noteworthy of them being the Saqlawiya Canal which takes off from the Left Bank between Fallujah and Sinn-al-Dhibban, and the Yusifiyah Canal taking off from Imam Hamzah also on the Left Bank between Fallujah and Musaiyib.

About five miles below Musaiyib the Euphrates bifurcates into the Hillah and Hindiyah Channels. From this point the Hindiyah Barrage controls the water supply, and by means of it water can be withheld or given to either channel as required. By ponding up the river, a considerable increase can be effected on the water supply of upstream canals as far as the Yusifiyah.

The Hillah Channel acts as a feeder to a large number of canals which take of from both banks. These canals follow the alignment of very old canals dating from ancient times. Their remains are a distinctive feature of this particular area, and are in themselves a very interesting study.

The Hindiyah Channel extends to Kifl where it divides into two smaller channels, the Shamiyah and the Kufah which at their lower end are respectively known as the Ghummas and the Mishkhab.

Modern high-level canals take off from the Hindiyah Barrage and follow the course of the Hindiyah channel on either bank. These canals known as the Bani Hasan, and the Jorjiyah have brought land into cultivation which previously had to be abandoned owing to the Hindiyah Channel having scoured to such a depth as to render it useless in its upper reaches.

The Ghammas and Mishkhab areas are suited to rice cultivation, and being situated close to Najaf, there is a ready market for the rice, much of which also finds its way into the interior of Arabia as Najaf is one of the ports of the desert.

DISTRICT WORK.

Shortly after the arrival of Mr. Anson from Mosul, his activities were mainly directed to getting in touch with what was to him a new district with practices differing considerably from those prevailing in his old area. His time was principally taken up in getting into touch with cotton cultivators on the Yusifiyah and Saqlawiyah canals.

On the latter it was obvious that a Gazetted Officer was essential to the welfare of the canal ; and this fact was strongly urged by the Agricultural Circle Officer in his Report for May. This was the first year in which propaganda on cotton had actually commenced. To many its cultivation was new, and the habits of the plant strange. In many cases the land had not been sufficiently well prepared before sowing, nor properly tended afterwards. The operation of singling was rarely comprehended, and fassing, though understood, only indicated severe toil. That both are necessary will probably be appreciated in time by Arab cultivators, but patience will have to be exercised in demonstrating these two very essential operations. After all it must be borne in mind that many Arabs have only recently taken to cultivation, and that many should fail to understand that a better crop results from uprooting so many of the young plants in the process of singling should not occasion surprise. What does do so, however, is to find that many of those who failed last year are willing and anxious to try again. Whether their efforts will meet with greater success remains to be seen. So much depends on a guaranteed water supply, and experience in the past has gone to show that a sufficiency of water in the hot weather cannot be guaranteed in many cases. When the cultivator has to gamble on the supply of water he can hardly be blamed for not putting his best into his work.

One of the most promising cotton growing concerns on the Yusifiyah was that of Mr. Anwar Khaiyat. He started to grow an area of approximately sixty acres on a half share arrangement with his fallahin. In June his crop looked most promising. The land had been ridged, and an almost ideal germination secured ; plants were properly spaced, singling and fassing were being attended to, but the utmost care and attention availed nothing when the water supply failed. The superiority of the ridge system of sowing was most marked, and this year it is interesting to note that a number of cultivators intend to adopt it when the sowing season arrives.

PUMP SURVEY.

The lack of information concerning the number and variety of engines and pumps utilised for purposes of irrigation had been a long-felt want in the Department, but as the Department did not possess an Agricultural Engineer it was considered advisable to postpone work on this project until such time as a competent Engineer could be found to fill the vacancy. Various questions kept cropping up however necessitating information regarding the economics of pump irrigation in the country.

The most essential of these concerned the price of fuel oil and the cost of transporting same from the Oil Depôt at Khirr to the sites of the various plants. It was also necessary to find out how many engines and pumps imported into the country were actually being used solely for agricultural purposes. This question arose because of the attitude adopted by the Custom Authorities wishing to charge duty on all pumping outfits until such time as they were erected, and could be certified as being used only for purposes of irrigation. This attitude considerably handicapped importers of such machinery who were much inconvenienced by having to wait a very considerable time before a refund of duty could be obtained. Until a sale could be effected and the plant erected, months would elapse during which time the money sunk in Customs duty was a very serious consideration.

If it could be proved that all, or nearly all the imported outfits were used solely for agriculture, it is hoped that the Customs authorities may see their way to allowing such outfits to be imported duty free. With these objects in view the A. C. O., Baghdad, commenced work on the survey in June, and continued at it through July and August when he had to be recalled from the work in order to replace the Superintendent of the Government Experimental Farm at Rustam who was admitted to hospital on account of serious illness. The work has since been resumed, and when completed it is hoped that much useful and beneficial information will be gleaned from the figures collected in the course of the survey.

MISCELLANEOUS.

During the absence of the Officiating Deputy Director of Agriculture on leave from 7th September 21 to 11th October 21 the A. C. O., Baghdad, officiated as Deputy Director of Agriculture.

A. C. O., Baghdad, toured the Sulaimani Division during November 1921 at the request of the Director of Agriculture. The tour lasted for three weeks, during which time, Shah Bazher, Halabja, and Chemchemal were visited as being the main centres of cultivation suggested by the Political Officer. A very comprehensive report was submitted embodying the information collected, and the A. C. O's. opinions on the existing practices.

STAFF.

On closing down the Mosul Circle, the Baghdad Circle was started by Mr. R. R. Anson who however, had to take over charge of the Rustum Experimental Farm from 24th September 1921 to 15th December 1921 when he was relieved by Mr. Webster, the Deputy Director of Research.

Subsequent to Mr. Anson's departure to Australia on leave in December 1921 the Circle has been in charge of Mr. C. L. White who still holds the office. At the present time Mr. White is writing up the notes collected by him in the course of his survey of the engines and pumps on the Tigris and Euphrates.

Ibrahim 'Asil Beg acted as an Agricultural Assistant from 9th May 1921 to 15th September 1921 when he left the Department to take up his duties as Manager of the Quwairish Farm Company.

Mr. Menon has been District Agricultural Inspector, Fallujah throughout the year, and it is a pleasure to be able to record his untiring efforts in the interests of Agriculture in general, and cotton cultivation in particular.

Abdul Karim was transferred from Kut and appointed District Agricultural Inspector, Muhammadiyah, on 14 January 1922. He will there be in touch with the cotton cultivation on the Yusifiyah Canal.

G. S. CAMERON,
for *Agricultural Circle Officer, Baghdad.*

Administration Report of the Agricultural Officer, Diyala Circle.

GENERAL DESCRIPTION OF THE CIRCLE.

The boundaries of the Diyala Agricultural Circle coincide approximately with the boundaries of the area comprising the Liwas of Diyala and Kirkuk, and the Political Division of Sulaimani. The Circle is divided naturally into three distinct districts each with a type of farming suited to its soil, climate and geographical position.

Ba'quba District is sub-tropical and arid and practically all crops require irrigation.

Kirkuk District is semi-arid but can grow winter cereals without irrigation.

Sulaimani and Khanaqin Districts are semi-humid and can grow all winter and many summer crops without irrigation.

BA'QUBA DISTRICT.

The agricultural conditions in this district resemble, in many respects, the conditions in Lower 'Iraq generally. The District consists of that portion of the Tigris delta between the Jabal Hamrin and the River Tigris. The River Diyala flows through the centre of the district and breaks the evenness of what would otherwise be an almost level plain.

Climate.

There is a well marked winter in this District and from November to March the mean temperature is low. The summer months from May to September are hot and rainless and the diurnal range of temperature is extreme. During this period the relative humidity is low and there is a great deal of air movement, usually from the north-west. Evaporation and transpiration are therefore rapid and in fruit and vegetable growing devices for reducing the effects of the hot dry winds are essential. Mud walls, windbreaks of castors and hemp and the shade of date palms are used for this purpose Many young trees and vegetables are grown in deep trenches and thus receive still further protection. Two distinct growing seasons occur, the first between February and May and the second between September and November. Between these seasons vegetative growth is checked by the hot winds of July and August and the cold of December and January.

Soil.

The soil is a calcareous alluvium apparently deposited by the Tigris river. It is of a fine grained texture, porous and friable when of a medium moisture content. It readily runs together on the surface and loses its porosity after heavy rains or frequent surface flooding. Small areas of alkali land are common. The general tendency of the cultivator to over-watering leads to the production of these injurious salts. Fertility is maintained by bare fallows and in orchards and vegetable gardens by the addition of large quantities of animal manure. The sub-soil, as in most arid regions is of a texture similar to the surface soil.

Water Supply.

The total rainfall is low, about ten inches for the year. The volume of irrigation water is abundant during the winter but small during the summer. This cannot easily be increased. The usual means of irrigation is by flow from the canals taking off from both banks of the Diyala river near the Jabal Hamrin. Small areas near the river are irrigated by pumps and cherids. The chief problem underlying the improvement of summer cultivation is the discovery of the maximum duty of water ; the volume of irrigation water during the summer being small and not at present capable of any great increase. The dryness of the air and the hot winds accentuate the ordinary losses due to evaporation and transpiration. The general tendency to over-watering rapidly leads to the production of injurious alkali salts. Thus the ordinary losses of water from the soil cannot be made up by frequent irrigations and there is usually no advantage in concentrating the available water on a small area. The solution of the difficulty appears to be to apply as little as possible and reduce evaporation and transpiration to the minimum. Yield per unit of water applied and not yield per unit of land used should determine the relative values of summer crops in this area.

Crops Grown.

Dates and citrus fruits are the most important crops. Other fruit crops grown on a commercia scale are peaches, plums, grapes, figs, apricots, apples and pomegranates. Pears, cherries, nectarines quinces and mulberries are also grown, but in small quantities. Wheat, barley, beans, and vetches are the main winter crops ; while rice, maize, cotton, gram and lentils are the important summer crops. During the summer nearly all sub-tropical and such tropical crops as are annuals can be grown ; and during the winter most crops from the temperate zone do well.

Fruit Crops.

As in all lower 'Iraq, dates are the most extensively grown fruit crop. In this district citrus fruits and grapes closely follow dates in economic importance. Sweet oranges are the most important citrus crop and Dais al Anz the most extensively grown variety of grapes. Great improvements are possible—especially in citrus fruits—by isolation and propagation of the most suitable types. With

the varieties at present available in this country it is essential that sweet oranges and tangarines be grown under the shade of date trees. Certain trees, however, have been observed to exhibit greater resistance to sun and frost than others and it is possible that, by selection, a strain might be developed that could be successfully grown in the open. Should this be accomplished a much more rapid extension of the area under citrus fruits would be possible.

Field Crops.

Barley, wheat and beans are the most extensively grown field crops; barley being by far the most important. The quality of all cereals grown is very low and the fact that they are mixtures of several different varieties enormously reduces their value for export.

KIRKUK DISTRICT.

This is one of the great daim or dry-farming areas of northern 'Iraq. It lies north of the Ba'quba district; its northern and western boundaries are the Lesser Zab and Tigris rivers. The southern boundary is the Jabal Hamrin, and on the east lies a range of hills extending to the Persian border. The general gradient is from these hills to the Adhaim River which joins the Tigris below Samarra.

Climate.

The mean maximum and minimum temperatures are slightly below those of lower 'Iraq and the climate may be said to be on the border line between arid and semi-humid. The total rainfall is about 13 inches, most of which falls during the months between October and March.

Soil.

Along the streams and rivers gravelly loams predominate; on the open plain the soil varies from clay loam to light gravel. The prevailing type of the district is a medium loam of considerable depth overlying a heavier subsoil.

Crops Grown.

Wheat is the main crop of the district; other field crops extensively grown are barley, rice, maize, cotton and tobacco. Grapes, olives, apricots and most subtropical and temperate zone vegetables are important crops.

Implements.

The implements used are, in general, similar to those of lower 'Iraq, though the plough used is a distinct improvement on the one used below the Jabal Hamrin The general construction is similar, but the blade is broader and therefore more efficient as a weed eradicator. Better results would probably be obtained with a 'turnover' type of plough as it would avoid the ridging effect of the local plough and thus conserve more of the soil moisture.

SULAIMANI DISTRICT.

The Sulaimani District is bounded on the west by the Kirkuk District and on the east by the Persian border. Its northern and southern boundaries are as yet not clearly defined. The cultivable portion consists of the Halabja plain and a number of valleys and hillsides near Sulaimani.

Climate.

Mean temperatures are considerably below those of lower 'Iraq, and total precipitation is much lighter. Fairly heavy falls of snow are common during the period December to February

Crops Grown.

The main cash crop of the district is tobacco. Wheat, barley and grapes are extensively grown. Other important crops are figs, apricots, apples, peaches, plums and olives. A full agricultural survey of this district has not yet been undertaken and very few economic facts, therefore, are available. Given good transport facilities the possibilities of development are, however, apparent to the most casual observer.

SEASON.

The outstanding feature of the season under review is the comparative failure of the water supply over the whole Circle. On the Diyala canals the losses of summer crops due to lack of water were enormous, and in the daim areas of the Kirkuk district rainfall was insufficient to mature winter wheat and barley. Winter cereals on the Diyala and in the Sulaimani district, however, gave satisfactory yields. Yields of citrus fruits and grapes were heavier than has been known for several years. Early and abundant rain towards the end of the year gave all winter crops an excellent start and in the absence of disease heavy crops for 1922 appear to be assured.

DISTRICT WORK.

During the year under review district work was confined almost entirely to the Baquba area. In other parts of the Circle the work undertaken was of an advisory or routine nature. Shortage of staff and transport rendered it impossible to undertake other work.

Cotton Improvement Work.

Apart from the experimental work on the Ba'quba Experiment Station, cotton propaganda work was undertaken in 1921 for the first time.

Mr. Ghulam Husain was placed in charge of this work on reporting for duty in this Circle on April 15th. His duties were (*a*) to advise growers as to selection of sites and suitability of their land for cotton growing, (*b*) to distribute seed on payment, (*c*) to advise as to methods of preparation of land, sowing, thinning, harvesting and disposal of the crop.

About four tons of cotton seed were issued to cultivators and landowners. This was sufficient to sow about 350 acres. The greater part of this was sown and it germinated satisfactorily. Until about the middle of June all crops of this cotton were in a very promising condition. About this time the supply of water in the Khalis and Khorasan Canals became very irregular and the cotton crops suffered severely. Instead of the water supply increasing as the season advanced it gradually became less and by the end of July about two-thirds of the area sown had been abandoned owing to lack of water. The remaining one-third of the area sown was carried on to picking time and, on the whole, gave satisfactory yields. The failure of the water supply and consequent loss of so large a proportion of the crops has not, however, discouraged cultivators in this area. All who saw the cotton were impressed with its superior quality, and the fact that its market value in Baghdad was about double the prevailing price of 'Iraqi cotton has proved a strong inducement to cultivate cotton during the coming season. The latter fact, together with the prevailing low prices of cereals, has resulted in a greatly increased demand for seed for the season of 1922.

Other District Work.

Was undertaken or continued in the following lines :—

(*a*). *Silk*—One hundred packets of silk seed were imported and distributed on payment to cultivators who had previous experience in the rearing of silk worms. The seed arrived in fairly good condition and on the whole, satisfactory results were obtained. At the end of the year an Arab Assistant who had been trained in sericulture at Kashmir was posted to this Circle. The programme of work for 1922 includes demonstration of modern methods at Ba'quba and Kharnabat.

(*b*). *Rice*—An economic survey of the rice districts on the Diyala Canals was undertaken by Mr. Ghulam Husain. His report on this is in course of preparation.

EXPERIMENT STATION-BA'QUBA.

The work on this Station during the year was mainly reconstruction and preparation for future experiments. Following the disturbances of the summer of 1920, during which all buildings were destroyed and all records lost, the Station was reopened on September 1st, 1920. The following experiments were undertaken in addition to the work of restarting the farm :—

Varietal tests of wheat and cotton, and experiments to test the suitability of imported varieties of flax, maize and groundnuts to the conditions prevailing in this district. Bersim (Egyptian Clover) and Hurtman (Vetches) were grown as green manure crops ; Barley and Lucerne as fodder, and about 60 acres of a Punjab variety of wheat were grown for seed.

The work of the Station proceeded satisfactorily during the first half of the year. The seed and fodder crops sown the previous autumn were harvested in good condition and satisfactory yields obtained. Early in June the shortage of water began to be felt and throughout the period from June to September water was rarely available when required. During the past three years the same difficulty has been experienced. This naturally raises the question as to the suitability of the present site for experimental work.

A summary of the results of experimental and seed crops is given below.

EXPERIMENTS.

Experiment No. 1.

To Discover the Relative Yields of Different Varieties of Cotton. Five varieties were grown, in six series, all on 1/20th acre plots. Varieties tested were Webber 49, Rustam 6, Hartsville, Rustam, 1 and Local. All were sown on ridges three feet apart, except Local, for which the ridges were 2 feet 6 inches apart. Hills were 15 inches apart in the rows in all varieties. Plots were long and narrow —132 feet by 16½ feet—the length of plots and direction of ridges was east and west. The land was ploughed, cross ploughed and ridged early in March and the crop sown on the 28th, 29th and 30th of March. Ten plots were sown each day. Germination was good in all varieties except Local. All blank spaces were resown during the third week in April. Thinning to two plants in each hill was completed by the end of May. All plots were given intercultivation as needed until the middle of June.

The plants suffered lack of water at intervals during June, July and August when the need was greatest. This resulted in the loss of many of the earlier flowers and bolls and considerably reduced the weight of the first three pickings.

The total number of irrigation works out at an average of 18⅔ for each plot. This should have been more than sufficient but proved to be inadequate owing to the fact that water had to be given when available and not when required.

The first picking was taken on the 8th to the 11th of August and subsequent pickings as nearly as possible every seven days until the 23rd of November, on which date the final picking was taken. The average yield per acre for each variety was as follows :—

Rustam 6 (Webber)	952 lbs.
Rustam 1 (Webber)	937 ,,
Local	903 ,,
Webber 49	883 ,,
Hartsville	859 ,,

Two rows showing the most uniform growth were selected in each plot as observation rows, the rows being labelled 'A' and 'B' in each plot. Sixty rows in all were selected and the number of hills in each row counted. The produce of each of these rows was picked and weighed separately and from this the average yield per hill calculated.

Average yields per hill in observation rows and plots are given below in decimals of a pound.

Variety.	Observation Row 'A'	Observation Row 'B'	Plot.
Rustam 6 (Webber).	.08383	.08013	.07836
Rustam 1 (Webber).	.08333	.08211	.0772
Webber 49	.07464	.07032	.0729
Hartsville	.07141	.07379	.07065
Local	.06441	.06480	.0639

The object of this work with observation rows was to discover the correlation between plant yield and plot yield. The whole of the data collected, the averages of which are given above, indicate that a very close correlation exists between plant and plot yields.

The natural corollary of this appears to be that given a sufficiently large number of observation rows, in which the number of plants is known, to allow the laws of chance to operate, this method may be successfully used to determine relative yields for varietal tests and also to determine yields where weighment of the total crop is not practicable.

Experiment No. 2.

To Discover the Relative Yields of Different Varieties of Wheat. Six varieties were grown in five series, *i.e.* thirty plots in all. Each plot measured 132 feet by 16½ feet, *i.e.* 1/20th acre.

The preliminary cultivation of the land consisted of an initial irrigation early in October to germinate weed seeds and a ploughing to destroy them. Just before sowing the land was ploughed cross ploughed and harrowed. The seed was then broadcasted at the rate of 80 lbs. per acre and ploughed in. The clods were then broken with a levelling board. Sowing was begun on the 8th of November and completed on the 15th. All plots had germinated by the 28th of November and steady growth was maintained in spite of the exceptionally low temperatures experienced early in December.

The plots were given three irrigations in all theween sowing and harvesting the first on the 19th March, the second on the 2nd April and the final on the 24th April.

All plots were harvested on the 19th and 20th of May giving average yields as follows :—

Cross 3	1,964 lbs. per acre.
Punjab 15	1,924 ,, ,, ,,
A. 8	1,836 ,, ,, ,,
B. 8	1,668 ,, ,, ,,
Punjab 11	1,630 ,, ,, ,,
A. 113	1,612 ,, ,, ,,

Experiment No 3.

To test the suitability of an Imported Variety of Maize to Local Conditions.

The variety tested was a 'dent' maize known as U. S. A. Selection No. 77, and was obtained from the United States Department of Agriculture. One twelfth of an acre was sown on August 14th. Germination was good and the plants made excellent growth throughout the season. Maize stem borer attacked the crop in September and considerably reduced the number of plants and, consequently, the yield. The total yield of this plot was at the rate of 768 lbs. per acre. This is considerably higher than the average yield of local varieties, and the future behaviour of this variety will be watched with interest.

Experiment No. 4.

To Discover the Optimum Date for Sowing Bersim.

Four sowings were made at intervals of ten days, the first sowing being on the 20th October and the last on the 19th November. All sowings were made in pentiplicate on plots 66 feet by 16½ feet, *i. e.* 1/40th acre each. The seed was soaked in water for 12 hours before sowing and then mixed with dry sand. The plots were irrigated immediately before sowing and the seed sown in the water. The first two sowings germinated in three days. Later sowings required 7 to 9 days for germination. The crop made steady growth during the winter and was very little affected by frosts and cold winds.

Average yields of green fodder, seed and straw are given below :—

Date sown.	Green Fodder cut 30-3-21.	Seed Harvested 15-6-21.	Straw.
20-10-20	13,776 lbs. per acre.	56.5 lbs. per acre.	1420 lbs. per acre.
30-10-20	14,144 ,, ,, ,,	68.0 ,, ,, ,,	1380 ,, ,, ,,
9-11-20	9,864 ,, ,, ,,	78.0 ,, ,, ,,	1200 ,, ,, ,,
19-11-20	—	54.4 ,, ,, ,,	296 ,, ,, ,,

From the above figures it will be seen that of the four sowings the first two gave the highest yield of green fodder and the third gave the largest amount of seed. November 19th appears to be too late for either green fodder or seed production.

BULK CROPS.

Wheat, Punjab 11.

One ton of seed of this variety was sown on four feddans (approximately fifty acres). The crop was grown on shares with a local cultivator. Land and seed were provided by the Experiment Station and all labour by the cultivator.

The land was prepared and the seed sown by the local method. Germination was good and the crop made satisfactory growth throughout the season. The total yield from the one ton of seed sown was fifteen tons 352 kilos.

After harvest the crop was divided as follows : one third to the Government as taxes, one third to the cultivator and the remaining third to the Experiment Station ; the Experiment Station's share of the crop being five tons 117 kilos. This was later despatched to the Central Experiment Station, Rustam, for further propagation.

STAFF.

Mr. C. Gautby remained in charge of the Circle throughout the year and in addition officiated as Deputy Director of Agriculture from July 22nd.

Mr. Ghulam Husain joined on April 15th and was posted as District Agricultural Inspector and from September 1st also carried out the duties of Farm Manager.

Mr. J. Fernandez remained as Farm Manager until August 31st, when he was transferred to the Central Experiment Station, Rustam.

Abdullah Faiq Effendi joined on August 5th and was posted as Assistant Farm Manager.

Mr. D. R. Swamy remained as Circle Clerk until September 30th, when he was appointed Assistant Farm Manager in charge of records.

Saiyid Ibrahim Effendi joined on December 29th and was posted as Silk Assistant.

I here wish to record my appreciation of the initiative and energy displayed by Mr. Ghulam Husain in carrying out his duties under very difficult and trying conditions.

C. GAUTBY,

Dated 20th February, 1922 *Agricultural Circle Officer, Diyalah.*

Administration Report of the Agricultural Officer, Basrah.

INTRODUCTORY REMARKS.

Upon my return from leave in the United Kingdom in September 1921, I was posted to Basrah to open a new circle, which came into effect from 16th September, 1921.

During the previous year Basrah had been part of what then comprised the "Lower Tigris Circle" with Head quarters at Kut al 'Amarah, and consequently only periodical visits could be paid to this Liwah.

For the short period the circle has been in existence, the staff employed has been confined to one clerk, Mr. Rajaratnam late of Mosul circle, who opened the new office at Basrah.

It is hoped that the employment of a suitable local assistant and additional local clerk will be arranged early in the year 1922.

A. GENERAL DESCRIPTION OF TRACT.

The Basrah circle stretches through the Basrah, 'Amarah and Nasiriyah Liwahs. It extends upstream to 'Amarah on the Tigris and to Samawah on the Euphrates and downstream to Fao on the Shatt al Arab.

A casual survey of the circle as a whole immediately draws attention to the chief sources of agricultural wealth at present in existence.

1. The Date Palm Tracts.

(*a*) This includes the most extensive area of date cultivation in 'Iraq—Shatt al Arab—extending from Qurnah to Fao, a distance of one hundred miles (approximately) Date palm cultivation exists on both banks of the Shatt al Arab to varying widths of one half to four miles on either bank.

(*b*) The other date belt of importance in the circle is that of the Lower Euphrates, extending from Nasiriyah through Suq al Shuyukh to the Hammar lake—a distance of 30 miles (approx.) and to an average width of one half mile on either bank.

2. The Rice Tracts.

(*a*) On the 'Amarah canals—The largest of the canals in order of precedence from the point of view of rice cultivation are:—

1. Chahalah and Musharrah (Albu Muhamad Tribe).
2. Butairah (Azairij Tribe).
3. Majar al Kabir (Albu Muhammad Tribe).

This area is practically all 'Miri' (Government) and Sanniyah (property of the Crown—pre war—Sultan 'Abdul Hamid). The lands are let out by Iltizam.

(*b*) The lower Euphrates canals in the Suq al Shuyukh district and the Hammar lake.

(*c*) Shatra district at the foot of the Shatt al Gharraf.

3. Tidal Inundated Areas.

The effect of the contrary current due to the tide from the Persian Gulf influences irrigation up to Qurnah and at the same time it helps to swell the Tigris as far North as Ezra's tomb.

From Qurnah to Fao the date palm belt is irrigated twice daily by the action of the tide, which forces fresh water into the numerous creeks which intersect the area.

The types of cultivation undertaken in the date gardens vary considerably.

(*a*) Cereals—wheat and barley are to be found throughout the date belt from Fao to Qurnah

(*b*) Lucerne—This luguminous fodder crop is extensively grown by the larger mallaks south of Basrah.

The crop is allowed to stand for 4 to 7 years and its popularity is largely due to its value as a "Soil improver crop" and the small amount of labour required for its cultivation.

(*c*) Vegetables—Winter and Summer vegetables are grown in gardens in close proximity to owns and villages.

(*d*) Fruit trees—The cultivation of fruit trees is adopted in many of the gardens and fig, apple, peach, nectarine, apricot, sweet and sour limes, oranges, tangerine and pomegranates are to be found planted between date palms and along the banks of the canals.

These crops are not subject to tidal flow irrigation throughout the year and although the date palms and fruit trees obtain sufficient water from the net work of creeks and canals, the cereals, fodder crops and vegetables require additional surface irrigation, which is carried out by means of various types of water lifts at high tide.

With the advent of spring flood arises the difficulty of preventing the whole area of cultivation being flooded and this is done by the building of 'Flood walls' on the Shatt al Arab and main creeks.

4. Flood Irrigated Area.

The largest flow irrigated area in the circle extends from 'Amarah to Ezra's Tomb on the Tigris. This includes the following canals controlled for river conservancy:—

(*a*) Chahalah (Regulator built 1919).
(*b*) Majar al Kabir (Regulator built 1919).
(*c*) Michiriyah (Regulator built 1920).
(*d*) Butairah (in construction).

The cultivation on the upper reaches of these canals consists of Winter crops—wheat and barley while on the lower reaches safi crops are grown—rice, maize and green gram.

On the Euphrates flow irrigation extends throughout the Nasiriyah Liwah, the Samawah district being influenced by the Hillah and Shamiyah branches of the Euphrates.

The Sayih canal near Nasiriyah is controlled by a Regulator. The cultivation is chiefly Winter crops—wheat, barley and vegetables. Rice is largely grown north of Samawah.

5. Lift Irrigated Area.

The lift irrigated area is confined to a small area on the banks of the Tigris and Euphrates and upper reaches of main canals, shitwi wheat and barley and vegetables and safi vegetables being the principal cultivation.

6. Marsh Area.

The largest marsh area extends from below Suq al Shuyukh to Qurnah (Hammar lake) and south to Qarmat 'Ali, near Basrah.

The lower reaches of the 'Amarah canals extend to Haurs on either bank of the Tigris, while the tract from the Ezra's tomb to Qurnah on the Tigris is almost entirely marsh lands.

The cultivation bordering the marshes is chiefly rice combined to a lesser extent with the growing of the maize, sesamum and green gram according to local conditions.

Thus in the 'Amarah and Suq al Shuyukh districts rice cultivation is the main crop; while on the Tigris south of Ezra's tomb and on the Suwaib river maize is more extensively grown.

The water of the Qarmat 'Ali marshes has been gradually receding and forming several islands which owing to the silt deposit are exceedingly fertile and are being taken up for cultivation.

This is probably due to the construction of the dry cut from Bani Sa'id to Mazliq, forcing more water down the Qurnah channel of the Hammar lake.

The marsh Arab is not a cultivator, although some have shown desire to settle down on the borders of the marshes and cultivate in preference to relying entirely on buffaloe herding for subsistence.

An extensive area in the Hammar lake is covered with reeds and inthis locality the "reed cutting" is the main industry of the marsh Arabs.

The reeds are placed on the river in large stacks aud floated downstream.

The Government collects revenue on the reeds.

7. The Season 1921.

(*a*) The date crop as a whole was considered an average crop and of the three main commercial varieties, Sayar, Halawi, Khadhrawi, the Halawi date crop which was harvested first was found to be slightly below the average yield.

Prices fluctuated considerably and Halawi dates rose from Rs. 450/- per Kara (40 maunds) early in the season to Rs. 650/- per Kara (40 maunds) at the end of the season.

(*b*) The winter crops—wheat and barley were well below the average owing to the abnormally low rainfall and short flood season.

(*c*) The sowings for the 1922 winter crop were greatly facilitated by the seasonal rains of November, December and a greater area than usual has been sown. These early sowings have made excellent progress and, given a normal rainfall in 1922, a good wheat and barley harvest is predicted.

B. DISTRICT WORK.

District work has been confined chiefly to tours of inspection of the circle for the collection of data of agricultural value or for advisory purposes, and this has somewhat been restricted owing to transport difficulties.

1. The Shamiyah rice area was visited in October and a number of acknowledged varieties collected together with specimens of each showing various characteristic distinctions.

A note, on observations made during the tour with special reference to economic factors relating to the transport of rice, has been submitted to Baghdad—Appendix "A" Monthly Report for October 1921.

2. Arrangements were made for Messrs. Cotterell & Greig to carry out Fordson Tractor plough demonstration near Basrah on 12th November. Two Fordson Tractors, with a two-furrow Oliver self lift plough attached to each, were demonstrated and did remarkably good work.

A good deal of interest was shown by the malaks and among those who witnessed the demonstration were—Ahmad Pasha Sana' (Mutasarif Basrah) Hashim Beg al Naqib, Mustafa Beg al Mandil, Jamal Beg, Shaikh Yasin Bash'ayan, Haji Mahmud, Mr. Gabriel and others.

C. LAND DEVELOPMENT SCHEMES.

(*a*) Aluwi.

Sumair Beg, Basrah, desired to develop a tract of land near Haur Aluwi, four miles north of Qurainat station on the Basrah—Nasiriyah line. The land was inspected and the proposals drawn up (Ref. this office No. 4/B/32 dated 14th October, 1921). The scheme is at present in abeyance owing to the ownership of the land being under dispute.

(*b*) Qarmat 'Ali.

Jamal Beg has been for some time anxious to construct a protective bund from Qarmat creek to Shu'aibah bund and so prevent the flood waters of the Euphrates spreading over a large area of his estate, which is liable to occur in the event of a high spring flood. In conjunction with Mr Anderson, A. I. O., Basrah, the area concerned in the proposed scheme was visited on the 18th and 19th December, 1921, and proposals were made (Ref. Appendix "A" Monthly Report for December 1921.) Later a profile of the bund was erected and a section built for the guidance of the malak.

This construction will give protection from flood to 1,500 acres (approximately) of cultivation—date palms, winter and Summer crops ; also 2,000 acres (approximately) of uncultivated land.

The latter area is inclined to be saline but can be reclaimed and is valuable owing to its close proximity to the Basrah markets.

(*c*) Hummah Agricultural Company, Keteban.

The progress with the development of the estate has been anything but satisfactory and Mr. Gabriel has experienced the difficulties predicted in previous reports from this office, because he failed to realise the importance of any preliminary survey work in spite of the technical advice offered.

Five oil engines (Wilson) of different horse power were originally erected at various points on the river bank and feeder channels leading into the desert constructed.

When water was required for the 1920-21 Winter crops, it was discovered that the land which it was proposed to irrigate was not under control and in consequence of the two thousand acres wheat and barley sown most of it failed to germinate and what did, did not yield a seed return.

A central pumping station has now been built and three pumps are being erected to form a battery to discharge into one large, main-feeder, high level canal. The main feeder is 6,000 feet in length (approximately) and has been raised to a height of 10 feet at the pump house gradually tapering down towards the natural surface.

The construction of a tidal canal is nearing completion to take tidal water to the old and almost derelict date gardens North of Keteban.

In the absence of contoured survey it is impossible to say whether or not these two canals have been constructed on the best site for commanding the irrigable area.

A Saunderson Tractor with plough and cultivator has been used for putting down the 1921-22 Winter crops and has given complete satisfaction.

This year's early shitwi sowings have germinated well and promise to make a fair crop.

Some of the seed which failed to germinate during the 1920-21 season germinated with first rains of this autumn, and although thin on the ground will give a seed return providing sufficient rain falls during the spring.

The danger of the accumulation of salt in the soil by excessive irrigation, without an adequate system of drainage, is an important factor in the future development of the estate.

Areas of land which were irrigated last season now show distinct signs of salinity.

A considerable amount of money has been invested on the estate, some of which has been borrowed at exorbitant rates of interest varying from 18 to 30 % per annum.

A good deal of capital expenditure could have been saved, had a contoured survey of the estate been made prior to the development.

The Kutaiban enterprise is one which should be successful under expert management.

Much valuable knowledge has been gained by the errors of the past twelve months and in spite of existing liabilities, the scheme has a chance of success.

(*d*) Basrah.

Salih Beg Husni, a malak of Basrah, who has been living in Egypt since 1914 has obtained permission to bring out a party of Egyptian labourers experienced in cotton cultivation, and other personnel to develop his estate on model lines.

He is expected to arrive at Basrah early in 1922.

The estate of Salih Beg Husni is situated between the Shatt al-Arab and N. Shatahbah (a branch of Qarmah creek) and is bounded in the North by the estate of 'Abdul Latif Mandil.

That part of the estate not under date palm cultivation and presumably intended for cotton, is inclined to be saline and without reclamation is not suitable for cotton cultivation as a whole.

Small areas free from salt might be selected, but this does not appear to be economically sound for commercial enterprise. There is however no justification for further criticism of such an enterprising scheme until the arrival of Salih Beg Husni, when the matter can be discussed with him.

D. GENERAL REMARKS.

It is evident that certain factors exist varying in localities, which in certain cases tend to hamper development. Examples in this circle are enumerated below :—

(a) The re-adjusting and defining of definite boundaries between Miri, Sanniyah and waqaf lands, is required.

The ownership of a great deal of land is at present under dispute and until a basis of settlement is reached any form of progressive development cannot take place.

(b) Fixed assessment of revenue for a definite period might be made with advantage in cases of Sanniyah and Miri lands, so introducing a sense of security of tenure.

(c) The discouraging of the malak who is an absentee landlord and who is entirely disinterested in the estate outside of receiving mallakiyah.

(d) When the country is in a reasonable state of security, the establishment of an Agricultural Bank, from which loans could be obtained for agricultural development at reasonable rates of interest, would be of great benefit to the agricultural community at large.

It is most satisfactory to find that so many of the malaks of Basrah are taking such an interest in the work of the department and it is hoped that next year greater facilities will be made for extending the work and conducting demonstrations and experiments.

W. D. GARBUTT,
Agricultural Circle Officer.

Dated February, 1922.

Administration Report of the Officiating Agricultural Officer, Kut.

The tract of country dealt with in this report was formerly a portion of the Lower Tigris Circle, with Kut as the Headquarters of the Circle Officer. This tract has now been included in the newly formed Baghdad Circle and is known as the Baghdad Sub-Circle. The boundaries of the Sub-Circle are from *Ctesiphon* down to *Shaikh Sa'ad* embracing the towns of *Jassan*, *Badrah* and *Zorbatiyah* north of Kut and *Hai Town* and *Qalat Sikar* are included. These two last mentioned towns lie south-east of Kut on the river Hai, locally known as the *Shatt-al-Gharraf*. The Sub-Circle can very conveniently be described under these separate districts and each one has its interest from an agricultural point of view. The three districts are (*a*) The Kut district which includes all the Riverain tract on both sides of the Tigris, (*b*) The Badrah district including the town of Jassan and Zorbatiyah, (*c*) Hai district with Qalat Sikar to the boundary of the Shatrah district.

(A). KUT DISTRICT.

Kut Town, Bughailah and Suwairah with a Shu'bah at 'Aziziyah are the important towns of the Kut district. There are a number of gardens clustered round each town. The cultivation of vegetables and cereals in a small way is the principal occupation of the gardeners. Date trees in these gardens are not found in such numbers as is usually the case in towns below Baghdad on the river.

Irrigation.

There are two classes of irrigation in this district (1) Lift Irrigation, (2) Natural Flow Irrigation.

(1) Lift Irrigation.

This class of irrigation is done by the modern Engine and Pump on a fairly general scale at the present time. There are still a few of the primitive Karad or animal power lifts working, but in the course of another few years it is probable that all these will be replaced by the Engine and Pump. Lift irrigation is largely confined to garden areas.

(2) Natural Flow Irrigation.

The majority of cultivable land between Ctesiphon and Shaikh Sa'ad is irrigated by natural flow in the flood season. Wheat, barley and greater millet are the usual crops planted. Planting of wheat and barley takes place from November onwards, and cultivators rely on favourable rainfall to germinate and keep the crop going until the flood season. Crops grown under this system are of very inferior quality in comparison to the same crops grown under Lift irrigation. From Kut downstream to Shaikh Sa'ad there is no lift irrigation done, all being done by natural flow irrigation.

(B) BADRAH DISTRICT.

Badrah, Jassan and Zorbatiyah are the towns of importance in this district. These towns lie north of Kut at distance of between 50 and 60 miles. Agriculture is the principal interest of the inhabitants. Wheat and barley are produced in very large quantities, also Dates. The *Badrawi* date is well known amongst local people as a very nutritious date. The local conditions of agriculture are much different to river areas, as also is the scenery very much more varied. The Pusht-i-Kuh Hills form a very imposing boundary on the north.

Irrigation.

All the irrigation in this district is done by natural flow from the stream known as the Gulal. This stream has two separate sources in the Pusht-i-Kuh Hills. The names of these two springs are the Ghurghol, and Changula and as they enter the plains they become the Gawi and Kungarcheni respectively. They converge on each other at Zorbatiyah, and from there onwards the stream is called the Gulal. It runs roughly from north-east to south-west and when in flood deposits its surplus water in the large marsh known as the Suwaikiyah which lies between Kut and Badrah. In the dry season the stream only just reaches Jassan.

(C). HAI DISTRICT.

Hai town and Qalat Sikar are situated south-east of Kut at distances of 21 and 44 miles, respectively. Both towns are on the river Hai. The river Hai takes off the Tigris at Kut and flows in south-east direction. It is linked up with the Euphrates by a number of small canals at a point five miles below Nasiriyah. It is not a perennial stream. Water usually enters from the Tigris in November and remains so until July. After then the Tigris drops to a level considerably below the present bed of the river Hai. The country on both sides of the river is known generally as the Gharraf. It is a large tribal district whose main interest is agriculture and cattle, especially horses of the best strains of Arab blood are bred in this district.

Irrigation.

Lift irrigation on the river Hai is only done on a very small scale principally in the gardens in the vicinity of towns. Stagnant pools of water remain in the bed of the river from July onwards till November. During last September lift irrigation on the Hai gardens was discontinued, because owing to the shortage of water the town was threatened with a scarcity of drinking water.

Basin Irrigation.

The very old Egyptian Basin system of irrigation is used largely in the district below Hai town The method is to fill depressions in the flood season and plant the following Autumn with wheat and barley. Crops grown under this system are usually confined to wheat and barley and are known by the local name of Chibis and the wheat grown is among the best types produced in 'Iraq.

THE SEASON.

A very light rainfall of 1920-21 winter combined with a late flood very seriously affected the yield of wheat and barley in the Kut district. The Badrah district was not seriously affected, not being dependent on the river. Harvesting of cereals became general towards the end of April, and late rains did much damage to wheat and barley in stacks. Altogether it was a very bad year for winter crops. Advantage was taken of the late floods to sow a maximum area of Millet. Yields of this crop were above the average. Late rains did much towards keeping grazing open until the summer had well advanced. This did much towards alleviating the acute situation caused by loss of winter crops on flow land. Summer crops have suffered from a very consistent high temperature and many months of hot winds, Sesamum, Gram, Cotton and Maize being the chief sufferers. Badrah rice was an average crop. Vegetables under lift irrigation and crops of melons, lubyah, etc. grown in the bed of the river were well up to average. The Melon-fly did considerable damage during the advanced Summer months, other vegetables and fruits were particularly free from disease.

DISTRICT WORK DURING THE YEAR.

Cotton Improvement Work.

The general progress of this work was to a great extent hampered by various changes of officials at the seed distributing season. Owing to the large area of which the Circle was comprised at the time it was impossible to get into the close touch with intending cultivators so necessary to the successful routine of the work. Political Officers who were giving the work every support were being replaced in rapid succession by local Political Officers. In addition I had just taken charge of the Circle and the time lost in the various duties of taking over and arranging transport, etc. all combined to adversely affect the successful carrying on of the distribution and planting work. By the time it was possible to get all round the district the time for planting had passed, and being the first year of seed distribution on a general scale cultivators through lack of a thorough knowledge of methods of cultivation had preferred to refrain from planting. This was certainly their best course, as to have planted during the first year without the necessary advice might have resulted in a crop which would have for years biassed their opinion on cotton growing. The main object in this tract is to get cultivators to grow in very small quantities so that if results are disappointing no harm is done, also they are able to get a better knowledge of the method of cultivation and of what is likely to be required when the time comes for them to grow on a larger scale. The Amir Rabi'ah who is one of the most influential men in the district and lives near Kut grew two acres and the crops showed great possibilities, but unfortunately through various tribal reasons he found it necessary to remove his pump further downstream in August, and the crop did not have the opportunity of showing what it was worth. His opinion of the cotton, however, may be imagined from the fact that he has given an order for 100 pounds of the same seed this year.

General Advisory Work.

Before advisory work can be done very extensively it is necessary to know all of the influential cultivators. This is an object which has been aimed at very largely throughout the year, and practically every cultivator has been visited in the Circle. Long talks on the different methods of cultivation and in general the many points that have bearing on the successful raising of crops have in many cases done a lot of good. They also result in cultivators realizing that they can always call and ask for advice at any time when they are near the Agricultural Office in Kut. Another object aimed at has been an endeavour to get cultivators to try crops other than their ordinary routine of crop growing. Up till now vegetables have been in great demand owing to large Military forces in the country, and now that the troops are being relieved the vegetable market is rapidly becoming over stocked. Consequently the price has dropped heavily and the production of vegetables has become an unprofitable proposition. Owners of land are usually very willing to take any line of advice, but owing to their method of paying labour, they are to a certain extent dependent on the labourers. The labourers have thus also to be consulted before any line of action is taken and to these people the sowing of any crops other than the ordinary rotation practised by them presents innumerable difficulties regarding the division of the crops at harvest. Local cultivators have been induced as far as possible to visit the Government Experimental Farm whenever they are in Kut. Opinions between them differ very much on the various methods of cultivation in vogue there. The ultimate results of these visits however is that in many cases cultivators have tried to lay out their land and canals more economically. Also various enquiries have been made regarding the possibilities of obtaining animals and implements similar to those used at the Farm. Such changes must of necessity come very slowly but as time goes on the necessity to alter the old methods of cultivation from an economical point of view must come.

INVESTIGATION AND INQUIRIES.

During the month of August and September fairly exhaustive inquiries were made into the economics of the cultivation of Chibis crops on the Gharraf. Useful and interesting information was obtained. It is hoped that the note will be published during the current year.

KUT EXPERIMENTAL FARM.

The Experimental Farm at Kut has now been in existence since 1st March, 1920. When first started it comprised a cherid and four acres of land; later an Engine was installed. This necessitated an extension of land, and in April of last year the site was surveyed, and an option over an area of 74 acres was asked for. The site of the Farm is a Tapu holding and difficulties have been met in getting the lease granted. It is expected, however, that a lease of the land for a period of three years will be granted in the immediate future.

Object of the Farm.

(1) The object of the Farm is to duplicate experiments of various crops conducted at the Central Farm under conditions existing in Kut. (2) That selected commercial seeds might be propagated to obtain pure seed for distribution to cultivators locally. (3) To demonstrate modern implements, and more economical methods of cultivation than are at present in existence in the locality.

LOCAL CONDITIONS DURING THE YEAR.

The late rainfall experienced during May caused a good deal of damage to wheat which had been cut and stacked. A very hot summer with an incessant strong wind for several weeks during the latter end of June and throughout July did not help the progress of cotton. The exceptionally low level reached by the river in the early part of September caused anxiety in the matter of getting water to the footvalve of the pump. Large sandbanks formed in front of the well mouth and water was just obtained by dint of much spade work. The removal of the Military Dairy Farm and Camp seemed at first to leave the Farm very much on its own resources for protection. The better quality of various stores at the Farm in comparison to those used by the Arab are very much of an attraction to the Arab thief. Numerous attempts have been made by them to possess themselves of various articles but so far only one robbery has been successfully carried through.

EXPERIMENTS

Summer Crops.

Experiment No. 1 Cotton.

An experiment in cotton was carried out this year at Kut with two objects in view. (1) That certain cotton experiments carried out at the Central Farm might be duplicated under conditions existing at Kut. (2) To discover the relative yields of the different varieties planted.

The undermentioned varieties were sown :—

Rustam 1.
Rustam 6.
Webber 49.
Local.
Hartsville.

Three acres were plotted into 1/10th acre plots, and the varieties were sown, so as to be well distributed over the area. Each variety was duplicated six times. The seed was sown on March 25th. Germination was good. Progress was very favourable until July, when the Engine failed.

The yields obtained were adversely affected owing to shortage of water. The yields of each variety per acre were :—

Rustam 1 (Webber)	...	...	...	...	...	475 lbs.
Rustam 6 (Webber)	...	...	...	...	...	597 „
Webber 49	...	...	...	...	...	404 „
Hartsville	...	...	...	...	...	460 „
Local	...	...	...	...	...	196 „

The value of the experiment as far as the collection of statistics is concerned, was considerably minimized by the breakdown of irrigation plant at the most critical period in the life of the plant in 'Iraq. A glance at the yields shows them to be far below the standard which cotton has attained in previous experiments in 'Iraq.

Experiment No. 2 Maize (Flint 193).

An imported variety of maize from America was planted on July 30th. The object of this experiment was to discover the suitability of a variety of maize to local conditions. The method of planting was, to sow two seeds in each hole at a distance of 9″ apart and 3′ between the rows. Weekly growth measurements were taken.

The growth of the crop was good throughout. An average growth of 6″ each week was recorded until the crop had reached a height of 5′ 10½″. The yield was poor owing to the fact that from the second week of its life the whole crop was unmercifully attacked by stemborer, (*Sesamia Cretica*), a disease to which all maize crops grown in the 'Iraq are more or less susceptible.

Experiment No. 3 Ground Nuts.

Four varieties of ground nuts were sown on 24th April, 1921 the object being to discover a variety best suited to conditions existing at Kut. The varieties were :—

Japanese-Large.
Japanese-Small.
Virginia.
Madras.

The seed was sown on ridges in 1/40th acre plots; good growth was made throughout the Experiment although irrigations were by force of circumstances somewhat irregular. The following yields were obtained per acre :—

Japanese-Large	...	...	...	...	...	1,200	lbs.
Japanese-Small	...	...	...	...	...	640	,,
Virginia ...	...	...	...	...	...	1,200	,,
Madras ...	...	...	...	...	...	1,080	,,

Excepting Japanese-Small, the yields of each variety were fairly consistent. From a commercial point of view Japanese-Large appears to be the most profitable crop to grow. It is a large nut, a good yielder, and a ready market finder.

EXPERIMENTS, (WINTER CROPS).

Experiment No. 1 Bersim.

This was an experiment to discover the most suitable date to sow bersim. Thirty 1/20th acre plots were laid out in September and sowings commenced on 1st of October, 1921, each sowing being duplicated six times, at fortnightly intervals. The crop is still standing.

Experiment No. 2 (Flax).

A plot of flax was sown on 7th of October, 1921 with the object of taking weekly growth measurements and also to discover the difference, if any, in the maximum height attained by flax planted in Autumn to flax planted in Spring. The crop has made excellent progress and has not yet been harvested.

Experiment No. 3 (Wheat).

Six varieties of wheat were planted on October 31st, 1921 in order to discover a variety which was best suited to local conditions, and which could be offered to local cultivators for sowing on a commercial basis.

BULK CROPS HARVESTED (1920-21 SEASON).

Wheat :—Three varieties of wheat harvested in April 1921, yielded as follows :—

P. 11 per acre	...	...	...	...	...	1,560	lbs
C. 3 ,, ,,	...	...	...	...	...	720	,,
Jassaniyah ,,	...	...	...	...	...	1,360	,,

The yield was favourable considering the season. The quality of the corn was below average owing to heavy rainfall whilst in stack.

FLAX.

This crop when harvested yielded 18 maunds of seed. Suitable arrangements for retting were considered too expensive in view of the fact that flax was not likely to be grown very extensively at the present stage.

The plants were retted in the river in August, and when scutched yielded $3\frac{1}{2}$ maunds of fibre. The work of scutching is very tedious without suitable machinery and local labour were not in much sympathy with the work.

Cotton.

Five acres were planted with cotton during the first week of April, this crop suffered more severely than the Experimental crop, priority being given to the Experimental crop in the matter of irrigations after the shortage of water in July caused by Engine failure.

BULK CROPS IN HAND (1921-22 Season).

Wheat.

Ten acres of P. 15 and 8 acres of C. 3 have been sown this winter. The seed obtained will be distributed to local cultivators. At the present time the crop shows every prospect of being very good.

Barley.

Two acres of barley grown for fodder for Farm animals were sown the 3rd week of December and is making good progress.

TREE NURSERY.

A number of different varieties of tree seeds were sown in February. The germination of the majority was very poor.

As the result of all sowings the following number and varieties of trees have become available for transplanting in the Nursery:—

Babool	3,500 trees.
Dalbergia sissoo	50 ,,
Persian Lilac	20 ,,
Robinia pseudacacia	40 ,,

MISCELLANEOUS.

The poor yield of 1921 summer crops may be attributed to the failure of the Engine foundation at the most critical time of the year. Up till the month of July everything was progressing very favourably and valuable statistics were anticipated from Experimental crops as well as having good bulk crops for demonstration purposes. In the early part of July it was noticed with great anxiety that the foundation of the Engine showed signs of cracking. The increasing demand of the crops for water made it necessary to run the Engine from dawn to sunset and the continued train gradually resulted in the foundation becoming worse, until on July 22nd it was shaking to such an extent that it was necessary in the interests of the Engine to discontinue running. It was found that a new foundation was the only remedy, and a month was required to complete this work. Very hot winds and a consistently high temperature did not tend to relieve matters, and it can easily be imagined with what anxiety the disastrous results of a month without water were watched. The situation was one with which probably every cultivator in 'Iraq has at some period been faced, and the only encouragement the Agriculturist has is to hope for better results with the next crop. In this case there is every reason, to believe that the coming wheat harvest will compensate to a large extent for the inadvertent loss to the summer crop.

LABOUR.

The labour troubles that are so often experienced in various parts of the country are not met with at Kut, and it is very gratifying to relate that the permanent labour employed at the Farm has remained practically unchanged since the Farm was first opened. The saving of time in instructing newly engaged labour can thus be imagined.

STAFF.

Various changes in staff have occured during the period under report. Mr. W. D. Garbutt availed of four months' leave on March 16th and I assumed charge of the Lower Tigris Circle in his absence.

Clerical.

Clerk V. R. Ghaisas was transferred to Rustam on August 10th as assistant to the Agricultural Botanist.

Clerk K. Vethamanickam was posted here on July 12th and relieved Clerk V. R. Ghaisas on August 10th. He quickly accustomed himself to the varied duties of a Circle Clerk and has given every satisfaction in the performance of his duties.

Farm Staff.

Mr. Avedis Boyadjian has been in working charge of the Farm from the commencement. He has shown himself as being very tactful with local labour, as well as having a very thorough knowledge of the general principles of running a Farm. He has cheerfully faced many disheartening results and his continued efforts against unforseen circumstances have been very much appreciated.

Mr. Abdul Karim was transferred as officiating District Agricultural Inspector, Mahmudiyah, on January 12th. He had till that time been for three years in the employ of the Agricultural Circle Office, Lower Tigris. He has performed many varied duties in a capable manner and it is gratifying to see that his efforts have been rewarded.

E. A. KINCH,

Officiating Agricultural Circle Officer,
Lower Tigris, Kut.

Dated 15th February, 1922.

Report of the Assistant Botanist on Cotton Experimental Work at the Government Experimental Farm, Rustam, in 1921.

GENERAL.

I was appointed Assistant Botanist to the Agricultural Directorate, 'Iraq, in January 1921. Landing at Basrah on the 9th of March, I reported for duty at Karradah (Baghdad) on the 20th of the month. Mr. H. P. Paranjapye, whom I succeeded, had already left for India, so I had to take charge of the work in his absence. He had been chiefly engaged with the collection and identification of 'Iraq flora, and compilation of information about the prevailing practices of vegetabie and fruit-gardening in the country, more especially in Baghdad and its vicinity. He took with him to India most of the specimens he collected with the object of identifying them there. When they are returned properly identified, they will form a useful nucleus of a herbarium.

I was still busy exploring the avenues of my future line of work, when I received orders to the effect that I was to assist in experimental work on Cotton. Consequently, on the 14th of April, 1921, I moved to the Government Experimental Farm at Rustam, where I was made responsible for the collection of all scientific data concerning cotton experiments.

SITE OF EXPERIMENTS.

All experimental work with Cotton up to the end of 1920 had been carried out at the Cotton Farm, Karradah. But with the closing of the latter in December of that year, the work was transferred to the Government Experimental Farm, Rustam. This farm is situated on the right bank of the river Diyala, about three miles above its confluence with the Tigris. The land has been under continuous cultivation for a number of years past, except for the extreme western end, (furthest from the river), which used to get flooded by the Tigris waters in per-war days. In texture, speaking generally, the soil is about 22% fine sand, about 57% silt (coarse and fine), and about 17% clay (*vide* pp. 14, Soil Survey of the Diyala Area by Mr. J. F. Webster, and Mr. B. Vishwanath). It is very poor in organic matter, and has available nitrogen only to the extent of .092 per cent.

The actual portion under experimental cotton in the year under report forms the B Block of Research Area. It has an area of about 20 acres, and is divided into 4 equal sized sub-blocks The soil is typical of the major portion of the farm. It bakes hard during the hot summer days, and develops large cracks on the surface after every irrigation. It is so poor in organic constituents that it does not support any weeds except for a few specimens of hardy ' Shok ' (*Prosopis stephaniana*). All cultural operations were rendered difficult, and whenever the soil was inter-cultivated, large heavy clods were left on the surface.

CROPPING SCHEME.

Early in the year a comprehensive programme of work had been decided upon by the Director of Agriculture, and a detailed cropping scheme issued. The experiments undertaken were as follows :—

1. *Main Varietal Test.* To discover relative yields and values, per unit area, of 17 different varieties of cotton.

2. *The Spacings Test.* To determine the optimum distance between ridges, and intervals between hills for the variety of cotton known as Rustam 6.

3 *The Cultivation Experiment.* To test the comparative values of Ridge, Flat, and Drill methods of cultivating cotton.

4. *The Irrigation Test.* To determine the optimum date of cessation of irrigations to cotton.

5. *The determination of relative per-plant yields* of 19 selections grown in single lines.

6. *Bulk propagation* of 8 selections from 1918 crop.

7. Propagation of seed obtained by cross-pollination in 1920.

DETAILS OF EXPERIMENTS.

Experiment 1. The Main Varietal Test.

The main varietal test was a comparative test for 17 varieties, four of which were 1918 selections from Webber 49, two from Allen's Long Staple, one from Punjab 285 F, and one from Ashmouni. Other varieties competing with them were Sakel-Sudan, Local, Nyassland, Cawnpore 9, Sudan, Webber 49, and Hartsville, the last being a selection of Webber type imported into the country from America only the previous year. Lastly there was Pima, an American- Egyptian variety, occupying the four central ridges of Sakel-Sudan plots because of the small amount of seed available. These 17 varieties were quintuplicated in 1/30th acre plots. Intervals adopted for local and Egyptian varieties were 30″ between rows and 15″ between seed-holes, while for all others they

were 36″ and 15″ respectively. Each hill was left with two plants after thinning and the total number of irrigations applied was 16 in all cases exclusive of the pre-sowing irrigation. All plots were intercultivated six times with hand fasses. The yield statement is as follows :—

Name of variety.	Parent	Total seed-cotton for 5 plots, Lbs	Total Lint lbs.	Ginning%
Rustam 1	Webber 49	20.85	5.00	23.98
Rustam 4	Webber 49	17.96	3.89	21.66
Rustam 6	Webber 49	21.74	4.80	22 08
Rustam 8	Webber 49	16.23	3.61	22.24
Rustam 10	Allen's Staple	20.22	4.38	21.66
Rustam 12	Allen's Staple	35.51	8.37	23.57
Rustam 18	Triumph	15.43	4.42	28 65
Rustam 20	Punjab 285 F	16.36	4.53	27.69
Hartsville	—	17.45	4.12	23.61
Cawnpore 9	—	25.93	6.96	26.84
Sudan	—	33.03	7.83	23.71
Nyasaland	—	21.13	4.72	22.34
Webber 49	—	13.57	2.87	21.15
Local	—	12.56	2.12	16.88
Sakel-Sudan	(Egyptian)	1.14	0.25	21.93
Rustam 36	Ashmouni	4.07	1.13	27.76
Pima	(Egyptian)	.13	—	—

The three most heavily yielding varieties (speaking comparatively) are Rustam 12, Sudan, and Cawnpore 9 in the order named. The outstanding feature of this experiment, as with all other experiments this year, is the extremely low yields recorded. The experiment is being therefore repeated in 1922. The low yields recorded may be ascribed to several causes, the chief of which are as follows :—

1. The extreme poverty of soil in organic matter; the seed-bed did not retain moisture for any length of time ; it dried up soon, cracked and caked hard, in fact, too hard for any seed to germinate unless the soil was kept constantly moist. The germination percentage was in consequence very low, and extensive resowings had to be made late in the season.

2. The absence of complete control over the water supply in large channels, which led to the sown seed being swamped, the germination being thereby adversely affected.

3. The extraordinarily hot and strong winds in July and August caused an extensive shedding of flowers and buds, and seriously reduced the number of maturing bolls.

4. The use of inexperienced labour in work involving a considerable amount of technique.

5. An uncertain water supply in mid-summer when a single day's delay in watering was sufficient to materially decrease the yield.

6. The absence of an efficient wind-break to protect the plants which were fully exposed to the hot dry winds of summer.

Experiment 2. The Spacings Test.

This experiment was conducted with Rustam 6, a 1918 selection from Webber 49. The experiment consisted in the use of ten different types of spacings under otherwise uniform environments, with the ultimate view of making a comparison of the unit-area yields from them. The spacings adopted were as follows :—

Distance between Ridges	Distance between Hills.
30″	6″
30″	9″
30″	12″
30″	18″
30″	24″
60″	6″
60″	12″
60″	18″
60″	30″
60″	48″

The spacings were quintuplicated in 1/30th acre plots. All plots received a uniform number of 16 post-sowing irrigations during the season, and were intercultivated 6 times. The adverse conditions enumerated above also affected this experiment, and the projected idea of collecting comprehensive data

on flowering and bolling was abandoned. However, the average yields under the conditions obtaining at this site in 1921, favour 60″ between the ridges, as the following statement shows :—

Type of Spacing.	Average yield of seed-cotton in lbs. per plot.
30″ × 6″	2.30
30″ × 9″	2.70
30″ × 12″	3.20
30″ × 18″	2.44
30″ × 24″	2.49
60″ × 6″	7.06
60″ × 12″	7.73
60″ × 18″	9.46
60″ × 30″	7.75
60″ × 48″	8.77

The average yields are somewhat erratic, and the conditions under which the experiment was conducted were so abnormal, that it has been decided to repeat the experiment under more uniform conditions before drawing any definite conclusions. The experiment is being repeated in 1922.

Experiment 3. Cultivation Test.

This experiment was devised to test the comparative cropping value of the following three different methods of sowing cotton :—

1. To sow after the ordinary Egyptian method of sowing, *i,e.* on the southern face of ridges running east and west, and irrigating by letting water into the intervening furrows.

2. To sow in lines on a flat seed-bed, and irrigating the latter by swamping it as a whole.

3. To sow in lines on flat seed-bed, but gradually to convert the latter into a ridged plot when intercultivating, till as a result the system of irrigation has to be changed from that for flat plots to one for those with ridges.

The variety grown was again Rustam 6, and was quintuplicated in 1/16th acre plots, that were divided into 4 sub-plots each for purposes of irrigation.

The plots were sown on 30th March, and the seeds germinated in about 8 days. But the percentage of germination, as in other experiments was very unsatisfactory, and a large number of resowings had to be made about 5 weeks afterwards. This fact coupled with bad seasonal and other incidental factors not only brought about extremely low plot-yields, but also considerably marred the value of the experiment. The comparative total yields are as follows :—

Method of sowing.	Total yield of seed-cotton for 5 plots in lbs.
Ridges	23.41
Flat	17.31
Drills	24.80

The yields in a rough way point (*a*) to the superiority of Ridge and Drill methods of sowing over Flat method, and (*b*) that the sowing in lines to be converted into ridges later in the season (Drill method) is as good as that on previously prepared ridges. But these tentative conclusions may need revision in the light of subsequent experiments.

Experiment 4. The Irrigation Test.

This experiment was designed to determine the optimum date of cessation of irrigations to cotton. Eight different dates at intervals of 10 days, beginning with August Ist and ending with 18th October, were selected for the stopping of waterings. Again Rustam 6 was the variety sown. There were 8 sets of quintuplicate plots of 1/20th acre. As in other experiments the plot-yields were very low, and there is an absence of the gradual increase of yield which is anticipated in this experiment. This experiment also is being repeated in 1922.

Experiment 5. A Varietal Test for 19 Selections Grown in Single Lines.

The object of this experiment was twofold : (1) the propagation of some of the 1920 selections, seed of which was available only in small quantities, and (2) if possible, to carry out a varietal test for them, based on yields per plant.

For this double purpose 76 ridges, 48 yards long and 4 feet apart, were prepared, and seed of 19 selections was sown in quadruplicate series. The seed-holes were 3 feet apart on the ridges, and thus the plants were given soil surface large enough to keep them free from mutual root-interference. This fact and the * application of experience gained in the sowings of other experiments earlier in the season resulted in a much higher percentage of seed germination than that obtained in other tests. The plants made much better growth as compared with those in other experiments, but a few of them were killed in the seedling stage by white ants. This necessitated a larger percentage of resowings than would otherwise have been necessary. The seedlings were thinned out to one plant per hill, and the stunted plants were uprooted. In spite of the unfavourable conditions of soil and climate, and the unavoidable cultural difficulties attendent upon cultivation on a heavy sterile soil, the seed-cotton yields per plant were quite satisfactory. Rustam 12 and its selections (Rustam 47, Rustam 48, Rustam 49) gave the best results. Rustam 42, (a selection from Rustam 3 of 1918) was the next best, followed by Rustam 44, and Rustam 5.

*These selections were sown on 8th April, fully 10 days after the sowings for the Main Varietal Test were made.

The yield statement is appended below :—

Statement showing Data collected in quadruplicate single lines of 19 Cotton Selections.

Name of variety	Year Selected	Parent	Number of plants	Total Yield of		Ginning %	Per plant yield	
				Seed cotton	Lint		Seed cotton	Lint
				lbs.	lbs.		lbs.	lbs.
Rustam 1 ...	1918	Webber 49	175	16. 69	5. 35	32. 06	.0953	.0306 (v)
Rustam 2 ...	,,	Webber ,,	171	14. 00	3. 68	26. 29	.0819	.0215
Rustam 4 ...	,,	Webber ,,	167	15. 04	3. 80	25. 26	.0900	.0227
Rustam 5 ...	,,	Webber ,,	175	19. 07	4. 83	25. 32	.1089 (vii)	.0276 (vii)
Rustam 6 ...	,,	Webber ,,	174	17. 22	4. 51	26. 19	.0989	.0259
Rustam 8 ...	,,	Webber ,,	175	15. 30	4. 00	26. 14	.0874	.0229
Rustam 10 ...	,,	A.L.S.	171	14. 17	3. 35	23. 64	.0829	.0196
Rustam 12 ...	,,	A.L.S.	171	23. 79	6. 03	25. 35	.1391 (iv)	.0353 (iii)
Rustam 39 ...	1920	Webber 49	167	15. 51	4. 11	26. 50	.0929	.0240
Rustam 40 ...	,,	Rustam 1	171	14. 72	3. 97	26. 97	.0861	.0232
Rustam 41 ...	,,	Rustam 2	156	15. 36	4. 05	26. 37	.0985	.0259
Rustam 42 ...	,,	Rustam 3	172	20. 61	4. 72	22. 90	.1198 (v)	.0274 (viii)
Rustam 43 ...	,,	Rustam 8	172	14. 39	3. 73	25. 92	.0837	.0217
Rustam 44 ...	,,	Rustam ,,	169	18. 75	5. 02	26. 77	.1109 (vi)	.0297 (vi)
Rustam 45 ...	,,	Rustam 10	177	18. 82	4. 67	24. 81	.1063	.0264
Rustam 46 ...	,,	Rustam ,,	146	15. 72	3. 85	24. 49	.1077	.0264
Rustam 47 ...	,,	Rustam 12	168	23. 55	6. 53	27. 73	.1402 (ii)	.0389 (ii)
Rustam 48 ...	,,	Rustam ,,	163	22. 76	5. 45	23. 94	.1397 (iii)	.0334 (iv)
Rustam 49 ...	,,	Rustam ,,	141	22. 11	6. 29	28. 45	.1568 (i)	.0446 (i)

The yield of Lint per plant does not exactly follow the yield of seed-cotton per plant, because of the different ginning percentages of the various varieties. The order of arrangement based on Lint per plant is as follows :—

(i) Rustam 49
(ii) Rustam 47
(iii) Rustam 12
(iv) Rustam 48
(v) Rustam 1
(vi) Rustam 44
(vii) Rustam 5
(viii) Rustam 42

Rustam 12 and selections from it maintain their premier position both as regards yield of lint per plant and seed-cotton per plant.

In this experiment numerous flowers of all varieties were, by special treatment, induced to self pollinate during July and August. Incidentally, the number of days required for boll-maturation by different varieties was determined. It was found that the period of maturation varies for flowers opening at different times of the flowering season. Thus for example, in many cases the 45 days required by flowers opening in mid-July to mature their bolls, increased to about 58 days for those opening in the first week of September. Unfortunately no records were collected for flowers opening either before mid-July, or after the first week of September. The matter will be investigated more fully in the coming season.

Experiment 6. Bulk Propagation of 8 Selections From 1918 Crop.

The Selections mentioned below were grown in 1/5th acre plots for propagation, and a comparison of yields per unit area. They were originally selected as single plants in the 1918 crop, and were propagated in 1919 and 1920. For reasons already stated, the plot-yieds were very low, but as in Experiment 4 they indicate the distinct superiority of Rustam 12 over others The yield statement is as follows:—

Name of variety.	Yield per 1/5th acre.		Ginning%.
	Seed cotton.	Lint.	
	lbs.	lbs.	
Rustam 1	10.27	2.24	21.81
Rustam 2	14.03	2.96	21.10
Rustam 4	14.52	2.92	20.11
Rustam 5	13.31	2.80	21.04
Rustam 6	11.87	2.70	22.75
Rustam 8	12.99	2.98	22.94
Rustam 10	8.38	1.88	22.43
Rustam 12	22.42	5.63	25.11

The multiplicity of abnormal factors affecting the experiment does not permit the forming of any definite conclusions as a result of a single year's work.

Experiment 7. Propagation of Cross-Fertilised Seed.

In 1920 a number of reciprocal crosses were effected at the Karradah Cotton Farm, between an American (Rustam 6) and two Indo-American selections (Rustam 20 and Rustam 22). The seed available was in very small quantities, and was therefore sown in single ridges only. But either due to defective sowing or owing to the absence of fertility in the seeds, none of the seeds germinated, and so the plots had to be abandoned altogether.

SELECTION OF BULK SEED-COTTON.

In the height of the picking season, seed-cotton with staple of a marked length and strength, was picked from plants showing desirable characters, such as few vegetative branches, long and numerous sympodia with well developed large-sized bolls, tall habit etc. The selection was carried out both from the Research and the Estate crops, but was restricted to two varieties, Hartsville and Mesowhite. Four arbitrary classes were made as follows:—

1. Hartsville long: length of staple over $1\frac{1}{4}''$.
2. Hartsville short: length of staple over $1''$ but below $1\frac{1}{4}''$.
3. Mesowhite long: length of staple over $1\frac{1}{4}''$.
4. Mesowhite short: length of staple over $1''$ but below $1\frac{1}{4}''$.

The total weight of selected seed-cotton is about 60 lbs. for Hartsville and about 15 lbs. for Mesowhite. The four types will be ginned separately, and the seed will be propagated in 1922 for further bulk and single plant selection work.

GINNING PERCENTAGES.

The ginning percentages this year, like the plot yields, have been very low as compared with those for previous seasons. A critical perusal of them brings out the fact that there occurs a small rise in the ginning percentages after a particular time of the year. This period in the case of these experiments happens to coincide with the first fall of rain, the pickings after which were stored and ginned separately from the pre-rain pickings. It is possible that rain may have something to do with this increase in the ginning percentages, but nothing can be said definitely until more direct evidence is made available.

STAFF.

For the first few months the writer had to work single handed. He was later given the services of a field boy. Towards the close of the season he was given the assistance of an assistant manager. Mr. V. R. Ghaisis, of the Experimental Farm, Kut, was the first to hold this appointment. He did valuable work both in the field and in the office, but unfortunately he was recalled to India, and was repatriated early in December. In the beginning of January Mr. R. P. Desilva was appointed in his place on a month's probation.

ACKNOWLEDGMENTS.

My thanks are due foremost to Mr. R. Thomas, the Director of Agriculture, but for whose guidance and kindly suggestions the fate of the experiments might easily have been worse. I also feel grateful to Mr. J. F. Webster, Deputy Director of Research, whose advice and instructive criticism I sincerely appreciate. Lastly, Khan Sahib Ahmad 'Ali Sufi, General Manager, Rustam Farm, is to be thanked. His ready co-operation at every stage of the experiments was greatly valued.

K. D. SAWHNEY.
Assistant Botanist.

Dated 1st February, 1922

Report of the Assistant Entomologist for the year 1921.

(A) GENERAL.

I took over charge of the Entomological Work of the Research Section during the latter part of March, 1921. The following report covers the period from the beginning of April to the end of December.

Though occasional work has been done by different Entomologists at different times the systematic study of the economic insects of 'Iraq was practically started by my predecessor Rao Sahib Y. Ramchandra Rao, M.A., F.E.S.

The Rao Sahib's serious illness prevented him from submitting his notes on the different pests observed by him before leaving for India. In the absence of such notes I had to devote most of my time to the general study of the pests of this country. The following is a short account of the work done by the section during the year.

(B) ROUTINE.

The following economic insects and pests were received during the year for identification and suggestion for remedial measures.

1. Two lots, one from Rustam and another from Kut, of larvae boring into the stem of maize were received. They were bred in the laboratory and identified as *Sesamia Cretica*. Maize plants and stalks should not be left in the field after harvest, as they afford breeding places for the borers.

2. A sample of mole cricket, *Gryllotalpa* was received from Ba'qubah. It was found destroying young tomato seedlings. It is generally found in moist ground, especially along irrigation channels. Poisonous baits may be effective. By flooding the irrigation channels rather excessively so as to fill the burrows, the crickets are driven out and may be easily killed.

3. A sample of a *Fulgorid* bug of the sub-family of *Cixiini*, causing "*mann*" disease of dates was received from the Deputy Director of Agriculture. He mentioned that this insect causes "*sa'af*" disease of dates. Most probably "*sa'af*" and "*mann*" are the same disease.

4. A sample of tortoise beetles, *Chrysomelid* was received from Ba'quba. They were found feeding on safflower. As a rule this beetle does not develop into a serious pest. A spray of lead arsenate will effectively check the pest.

5. A sample of bean weevils, *Bruehus Obtectus* was received from the office of the Director of Agriculture, Baghdad. They were found feeding on imported seed beans. Fumigation with carbon bisulphide is a sure remedy.

6. A sample of Poplar galls was received from the Tree Nursery, Baghdad. These galls were also observed at 'Alwiyah and Rustam They are caused by an aphid, each gall being started by a single agamic form which gives birth to a large number of winged aphids. Hand picking of the galls and collecting them in a vessel containing a little kerosene oil is recommended as the best remedy.

7. The Assistant Political Officer, Zakho, reported that this year there had an unprecedented number of mice amongst the crop in the villages of Cham, Mishkko and Berzur et Alia. Strychnine sulphate poison has given good result elsewhere, and was recommended here. For this purpose 1oz, of Strychnine sulphate is dissolved in one pint of hot water, and one pint of heavy sugar syrup, ("debbes," or Arab date molasses, would serve well in this country) is added. Half a bushel of wheat is then stirred in this solution till all the wheat is covered with the liquid. The wheat is then left in the mixing vessel for twelve hours or more before it is distributed. Mice feed readily on this bait and are destroyed, but care must be taken not to allow valuable stock to eat it.

8. A number of chickens was received from Khanikin in August. It was reported that a scarcity of eggs in that district was noticed and on inquiry it was found that the hens were not laying eggs. The matter had been referred to some Kurdish Mulla who declared that there were two snakes in each hen, and ordered that all hens over three months old should be killed, otherwise the snakes would issue forth from the fowls and kill men.

The hens were under observation, and some were dissected. A few pairs of *Nematodes* with a tape worm were found in the intestine. Most probably these Nematodes were what the Mulla called snakes. The presence of the Nematodes does not indicate any serious disease. They are generally found in the intestine of many animals. The heat of the summer, in all probability, had something to do with the scarcity of the eggs. The Nematodes mentioned above were also noticed in the fowls procured locally. One of the diseased fowls began to lay eggs every alternate day after about a month.

(C) SILK.

1. A few cocoons of Eri silkworms *Attacus Ricini*, were received from The Imperial Entomologist, Pusa, with a view to find out the economic prospect of this silk in 'Iraq. Unfortunately the pupae died during transit. Another sample of seed cocoon has been asked for this winter.

2. A few localities were inspected where silkworms were being raised by the Arabs. The caterpillars looked quite healthy and robust. Some of the eggs of the last year did not hatch well.

(D) PUBLIC DEMONSTRATIONS.

1. The Mudir of Mu'adhdham reported that the presence of "*mann*" disease of dates was causing a considerable uneasiness among the growers. Accordingly a public demonstration of spraying as a control against "*mann*" disease was held early in July at Mu'adhdham at the garden of Saiyid Mustafa, a prominent Baghdad grower. One hundred badly affected trees were selected and sprayed with kerosene emulsion. Though the demonstration was conducted at a time when many of the adult insects have laid eggs for the next generation, it was shown that the insects could be readily killed with the kerosene emulsion. The best time for spraying will be May when all the eggs already laid have hatched out, and the new generation has not had time to lay eggs.

2. A demonstration against *Nezara Viridula*, which was found sucking tomatoes and causing them to rot, was also conducted at Mu'adhdham. It was also shown that a 10% kerosene emulsion will readily kill the bugs without hurting the plants in anyway.

3. On several occasions demonstrations against peach stem aphids, which may be regarded as a serious pest of peach were given at Jadriyah. Both soap with tobacco decoction and kerosene emulsion were found very effective. It is very encouraging to note that the farmer was so impressed with the result that he bought a sprayer for himself, and is having his garden sprayed regularly. Before he bought the sprayer his garden was found in a bad condition of infection, but after he bought it and commenced doing his own spraying, I am glad to note that his garden was practically free from the pest. The fallahs were taught how to make the spraying mixture, and now they are making their own solution.

4. Different fruit seedlings at the Tree Nursery Baghdad, were also successfully sprayed against aphids which were found in large numbers.

5. A quantity of copper arsenate prepared in the laboratory by the Assistant Chemist, was handed over to Saiyid Mustafa with instructions to spray his cabbage seedlings against caterpillars and other leaf-eating insects.

(E) SPECIMENS SENT AND RECEIVED.

1. In response to the request of the Imperial Entomologist, Pusa, samples of *Cydia Pomonella Phyto Phaga Destructor*, were sent to him.

2. A few specimens of *Anthomyiad* flies and a few capsid bugs were sent to Rao Sahib Y. Ramchandra Rao, as requested by him.

3. A few named insect specimens of 'Iraq were received from Rao Sahib Y. Ramchandra Rao.

4. A few specimens of Micro-lepidoptera were received from the Imperial Entomologist, Pusa, who was kind enough to identify them.

(F) IDENTIFICATIONS.

During the year, 92 samples of economic insects of 'Iraq have been kindly identified by the Imperial Bureau of Entomology, London, the Imperial Entomologist, Pusa, and Mr. E. E. Green.

(G) SPRAYING MACHINES.

The Department has sufficient sprayers to carry on small demonstrations.

(H) THE INSECT COLLECTION.

Up to the present there are 196 different species of pests registered, of which 96 have been named and 66 remain to be sent for identification. Collections from the systematic standpoint have also been made.

(I) TOURS AND OBSERVATIONS.

During the period under report I was away from headquarters for 50 days visiting Ba'quba, Basrah and other places. Below is a list with short notes of the more important pests of 'Iraq observed by me during the year.

1. *Cydia Pomonella.* Codling moth. This was noticed in a fair amount at different places attacking apples and peaches. In the United States of America and in Europe it is a serious pest of apples. Spraying the fruit buds after the petals have fallen, with lead arsenate or Paris green, is an effective remedy.

2. San Jose Scale- *Aspediotus Perniciosus.* This scale insects which is another serious pest of apples in the United States of America was observed by me at Ba'quba. Lime sulphur wash in winter is a good remedy.

3. The season of 1921 was a notable one on account of the great abundance of aphids and lea hoppers.

4. All along the shatt-al-'Arab from Nahr 'Umar to Muhammarah and practically in the whole of 'Iraq Ghabbar disease caused by a mite—*Otygonychus Sp.* was found doing considerable damage. This disease seems to be the worst of all the diseases of dates. It affects both the quantity and the quality of the fruits. The mites thrive only in a dry climate. As the year was particularly hot and dry, the infection was quite considerable, and in some places about 75% of the dates were found to be diseased. Spraying the fruits with a 10% kerosene-soap emulsion in June and July, followed by a similar spray after seven days, seems to be a successful remedy. One careful spraying should keep the mites in sufficient check for a few years.

5. "*Hashaf*" disease. Without further study and observation the real cause of the falling off of dates cannot be definitely stated. From the observations of this year it was thought that the cause of "*hashaf*" was a physiological one. Previous workers attributed the cause to the presence of a *Gelechid* larva. It is hoped that next year this disease will be thoroughly investigated.

6. "*Mann*" diseases of dates. This disease is caused by a *Fulgroid* bug of the sub-family *Cixiini.* The insect is found in 'Iraq only and is new to science. It has two broods in a year, once in spring and again in autumn. It affects both the quantity and the quality of the fruits, as well as he vitality of the tree. A kerosene emulsion readily kills the insects. A thorough spray in May, it is believed, will keep the pest in sufficient check. The pest occurs all over 'Iraq.

7. *Tortrix* moths. Early in the spring the freshly opened buds of apples, apricots, plums, etc., were found attacked by a leaf-rolling caterpillar of the family *Tortricidae.* These were found in a fairly large amount. Spraying with a stomach poison early in the spring will, I believe, be effective.

8. *Stephanitis Pyri.* This lace bug was found in fairly large numbers in Ba'quba and Jadriyah. Adults were collected early in the spring. Most probably they pass the winter in the adult form. Spraying the leaves with kerosene may be recommended.

9. *Earias Insulana.* Spotted cotton boll worm. This cotton pest was observed in large numbers everywhere where cotton was grown. After counting bolls from a number of plants it was ascertained that 30% to 70% of the bolls were injured by the boll worm. Fungus was also found to attack the bolls through the hole made by the boll worm. Later in the season, moths of *Earias Insulana* were bred in the laboratory which shows distinct colour variations in the forewing. This colour variation has also been noticed in Egypt. Each female moth is capable of laying 98 to 100 eggs. This number was found by counting eggs in the ovary of a number of moths captured while pairing. A number of *Braconid* parasites of *Earias Insulana* was bred in the laboratory. They were identified as *Rhogas Kitcheneri,* also found in Egypt as a parasite of *Earias Insulana.* After examination of a number of bolls it was found that parasitism does not exceed 30%. Removal and destruction of the cotton stalk and other allied plants after harvest will help in checking the pest.

10. Peach stem aphids. This was observed in large numbers on peach trees. Soap solution with tobacco decoction and kerosene emulsion were found very effective in instantly killling the aphids.

11. *Nezara Graminae.* This pentatomid bug was found in fairly large numbers on cotton bolls. They suck the juice of the cotton bolls by puncturing a hole. The boll does not develop well where it is sucked. This species is not mentioned as a pest of cotton, though a species of *Nezara* was found as a serious pest in the United States of America. Hand picking may be useful.

12. *Gelechia Gossypiella.* The pink boll worm. This pest has not been discovered in this country, though in Egypt it is a serious pest. Introduction of this serious pest should be avoided at all costs.

13. A caterpillar of the semi-looper type was noticed eating the tender leaves of cotton.

14. *Eurigastor Integriceps*-"*Sun*" disease of wheat. In the Mosul district this is considered a serious pest of wheat. They are also found in Baghdad and Ba'quba.

15. *Sesamia Cretica.* This borer was also found in fairly large numbers.

16. *Parlatoria Blanchrdi* and *Parlatoria Calianthina.* These scale insects are seen in large numbers. Lime sulphur wash in winter may be effective.

(J) ACKNOWLEDGMENTS.

My thanks are due to the Deputy Director of Agriculture (Research) Mr. J. F. Webster, for the help and suggestion which he has so kindly given me throughout the year.

A. DUTT,
Assistant Entomologist,
Department of Agriculture, 'Iraq.

Dated February 18th, 1922.

Report of the Assistant Chemist for the year 1921.

I reported for duty in Baghdad on the 1st March, 1921. Shortly after my arrival, I proceeded to Amarah to collect samples in connection with the 'Amarah soil survey. After about a month and a half I returned to Karradah, and since then the major portion of my time has been taken up in analysing these soils.

During the year under report the following estimations have been carried out:—

Mechanical analyses 43.

Estimation of water soluble salts 43.

Estimation of acid soluble salts 43.

The estimations of nitrogen are now in progress.

I have also carried out analyses of Tigris water every month since July, 1921. The fluctuations in the amount of solids in suspension and in the dissolved salts are shown below:—

Month	Solids in suspensions.	Dissolved salts.
July	13	21
August	15	20
September	3	21
October	6	27
November	6	27
December	15	40

The results are expressed in parts per 100,000.

In addition to the routine work, the following analyses were carried out:-

3 samples of water from 'Amarah.

1 sample of water from Hammar Lake.

3 samples of water from the Diyalah taken at Rustam.

4 samples of water from Ba'quba.

1 sample of water from Badrah.

1 sample of water sent by the Manager, Mosul Farms.

Total samples of water 13.

20 samples of soil from Rustam were analysed to determine their suitability for making bricks.

2 samples of sand sent by the Director of Irrigation were analysed.

1 sample of sand and 1 sample of shingle were analysed for the Executive Engineer, Floating Division P.W.D.

Meteorological observations were taken daily during the months of August to December.

S. TIWARY,
Assistant Chemist, Karradah.

Dated February 18th, 1922.

Report of General Manager, Central Experimental Farm, Rustam.

(A) GENERAL.

The Farm is situated on the Right Bank of the River Diyala about four miles above its confluence with the Tigris and about ten miles Eastward of Baghdad

Up to the present about 800 acres of this land have been canalised and cropped. The land was formerly cultivated by Arabs who grew a few Summer vegetables on the river bank, and their Winter crops of wheat and barley on the inland stretches where free-flow water was available during the flood season. Part of the land used to be subjected to periodic inundations but all is now protected to some extent by the flood protection bund.

(B) STAFF.

The Farm is under a Superintendent. The General Manager takes executive responsibility, and is assisted by a Manager of each of the three sections, Estate, Research and Farm Yard.

Each of these Managers has, in turn, fieldmen to assist him. A considerable number of local assistants have been tried, but owing to the distance from Baghdad and the discomforts unavoidable in a new undertaking, they are, as a rule, rather unhappy. Some of those who have put up with these draw-backs have, however, done valuable work. At the close of the year the staff stood as follows:–

Acting Superintendent.—J.F. Webster, Esq.

General Manager.—Khan Sahib A. A. Sufi.

Manager, Estate.—Mr. Gopal Singh.

Manager, Yard.—Mr. Ghulam Haidar.

Acting Manager, Research.—Mr. Khalil Ibrahim.

Assistant Manager, Botanical.—Mr. L.V. Ghate.

Assistant Manager, Tree Nursery Section. – Mr. J. Fernandez.

Fieldmen, Research.—Mr. Mulla Bakhsh,
Husain Ali Effendi.

Fieldmen, Estate.—Mr. Samuel Ephrahamian,
Ibrahim 'Abdul 'Aziz Effendi,
'Abdul Wahab Effendi.

Fieldman, Yard.—Ahmad Jamal Beg.

Foreman, Mechanic.—Mr. Bhansingh.

Acting Head Clerk.—Mr.K. Mukerji.

Typist.—'Abdullah Moshi Effendi.

Store Clerk.—Mr. J. A. Peters.

(C) LABOUR

When the Farm was re-started in Mid-October 1920, the season for engaging Agricultural Labour was over. Gangs of coolie labour were collected and with these and contract labour some shift had to be made. The men were neither accustomed to shovel work nor were they strong enough to do it, and the Tindal system which they imported with them was unsatisfactory, since these officials were responsible only for keeping up the correct numbers of their gangs. Constant changes of the personnel of the labour, and lack of any direct interest in the work on the part of the labour contributed towards a very unsatisfactory position of affairs.

In September, therefore, practically all that remained of this class of labour was dismissed and new labour was recruited on the local system of a year's contract. Labour is now divided into gangs of six men each with a "Charakchi" or working foreman. This system has been responsible for a great improvement in efficiency and has made it possible to place responsibility on the actual labourers

(D) CANALISATION.

When the work was re-started in October 1920 the old drains which had been dug by the Agricultural Engineer were used as a temporary measure as canals.

Owing to labour troubles these were used for a much longer time than had been intended. When cotton was to be sown in Estate in March labour was not sufficient for the work, and the canalisation was put out to contract with rather unsatisfactory results.

Accordingly when the new labour came in September recanalisation was promptly put in hand. This has gone on in conjunction with other work ever since, and, as each new crop has been put in, the canal system has been remade and realigned. The whole of Research Area has been re-canalised and laid out in permanent 1/20 acre plots of uniform shape and arrangement. The new canals give far more satisfaction, and this work was well in hand by the close of the year under report.

(E) CROPS.

1. Experimental.

The present area of the Farm is divided into two Major portions, *i. e.* Research Farm, about 100 acres, and Estate about 600 acres. All field experiments pertaining to Research are carried out in the Research Farm, and the Estate serves the purpose of a Seed Farm where bulk of the crop tested in Research Farm is grown for the production of pure seed. During the year under report however, it was not possible to stick to this distribution of work until the time of cotton sowing, irrigation facilities being the chief problem, the only water available up to that time being that from the small Shuttleworth Engine.

Most of the experimental plots had therefore to be put in the Estate nearer to the pumping engine so as to ensure timely irrigations. The following experiments were conducted during the year under report:—

Wheat and Barley.

1. *Smut control Test (wheat).* Nutrient solution tests(wheat and barley)
2. *Varietal Tests (wheat).*
3. *Single Line Propagation (wheat and barley).*
4. *Cotton:—*
   - (*a*). Varietal Tests.
   - (*b*). Spacing Tests.
   - (*c*). Flat, Ridge and drill methods of sowing
   - (*d*). Irrigation Test.
   - (*e*). Single Line Selections propagation.
5. *Alfalfa.* Single Line Seed Propagation.
6. *Maize.* Two varieties for seed propagation.
7. *Groundnuts.* Seed propagation.

Wheat Varietal Tests.

Six varieties were quintuplicated. The land was ploughed after the first rains of the new year, the seed sown broadcast and covered by a light ploughing. The land was not very uniform and plot fertility varied a good deal. In all, four irrigations were given. The average yields and varieties tested are shown below:—

Wheat Calculated as yields per acre.

Variety.	Grain in lbs.	Straw in lbs.
A. 8	1,110.5	1,565.3
B. 8	579.3	1,155.9
A. 113	852 4	1,287.5
P. 11	1,006.8	1,222.6
[illegible] 15	1,150.1	1,[illegible]57.8
Cross 3	1,114.0	1,367.9

Smut Control Test.

Wheat badly attacked by "*Smut*" was treated (a) with copper sulphate (b) with formaldehyde and tested against untreated wheat from the same sample.

Incidence of "*Smut*" was negligible and the experiment gave a negative result.

NUTRIENT SOLUTION TESTS.

These tests were arranged with barley and wheat in 1/20 acre plots duplicated 4 times. In about the middle of December 1920 four plots each of wheat and barley were sown with the seed steeped in the solution of the nutrients. The other 4 plots each were sown with seed steeped in water, with an equivalent of dry nutrients sown with the seed, and the remaining 4 plots each were sown with the seed steeped in water only. Unfortunately all this land happened to have been under vegetables in previous years, and so the manurial constituents of the land varied a great deal. In all, 4 irrigations were given and the crop was harvested in the beginning of June. A brief statement showing the yields follows:—

	Total weight of Crop.	Weight of grain.	Weight of straw.
Wheat:—			
Untreated	592.50	253.00	339.50
Water Treated	615.00	248.50	366.50
Nutrient Treated	571.00	266.00	305.00
Barley:—			
Untreated	463.50	256.50	207.00
Water Treated	550.50	295.50	275.00
Nutrient Treated	495.00	259.50	235.50

Cotton.

Block "B" of Research was prepared for the experimental cottons. Four experiments were located in this block:—

1. Varietal tests with seventeen varieties quintuplicated.
2. Spacing tests with 10 different spacings quintuplicated.
3. Irrigation tests with eight different dates of stopping irrigations, quadruplicated.
4. Flat, ridge and drill methods of sowing, each quintuplicated.

In addition 19 single plant selections were grown in single lines quadruplicated to study their habits; and 8 of these selections were grown in 1/5th acre plots as bulk crop for the propagation of seed.

All available seed of a few crosses which had been done in 1920 was also sown but none of them germinated.

The land had to be prepared in great haste and no irrigation could be given to the land before ploughing; consequently the texture of the soil was still somewhat cloddy when the cottons were sown.

The experimental work with cotton was handed over to the Assistant Botanist soon after the sowings were over.

Block D. was sown with bulk crop of Hartsville Cotton being Webber 49—3 selection received from the Pedigree, Seed Company, South Carolina, U.S.A. The germination was not good due to various uncontrollable causes. Further, due to scarcity of seed, resowing could not be undertaken. The plants made good growth, however, and soon filled up the gaps. Twelve irrigations and two fassings were done in this block. Total yield out of this 20 acres block has been 4,930 lbs. of seed cotton.

Alfalfa.

Small packets of five varieties of lucerne seed were received for the propagation of seed. Four of them were sown in Research block B, and the fifth had already been sown near the Nursery block. The seed was sown in the middle of April but due to the hot weather all these varieties made but little growth. They are doing better at this stage, and it is expected to collect some seed from them in the coming season.

Maize.

Two varieties *Dent 77* and *Flint 193* were sown early in August in 3/40 acre plots, separated from each other by a distance of about 400 yards so as to avoid the risk of cross fertilisation. Both these varieties, more especially the *Flint*, were attacked by the stem-borer. Tillering was good in both varieties but a great number of cobs were unfertilised especially in *Flint*. The crop was collected on 14th December, 1921 and amounted to 81 lbs. of *Dent* seed and 1 lb. of *Flint 193*. All the stalks were burnt immediately after harvesting so as to kill the stem-borer still present in them.

Ground-nuts.

All available seed of large Japanese, small Japanese and Madras varieties was sown in about an acre of land in the beginning of May. The ground was ploughed and ridged and the nuts were sown on the ridge. After 13 irrigations the crop was harvested in November. Calculated acre yields are shown below:—

Large Japanese	2,968½ lbs.
Small Japanese	1,630 ,,
Madras	1,800 ,,

Wind-Breaks.

Castor, Sun-hemp and Safflower were tried. A variety of castor with big broad foliage has been selected for use in the coming season together with Sun-hemp.

II. SEED PROPAGATION.

Bulk Wheats.

These were harvested and threshed in the threshing machine. Owing to lateness of sowing and subsequent difficulties in irrigation the yield was not good. The matured crop of 75 acres gave 34,428 lbs. of wheat.

Barleys.

Out of 7 acres put under barley four were cut green for fodder. The remaining 3 acres yielded 3,832 lbs. grain.

Small areas of Californian and Chilian barleys were also grown for propagation.

Bulk Cotton.

This crop was grown under considerable difficulties as regards irrigation, owing to the late time at which water became available, and the inexperience and unsuitability of the labour. The crop received 16 irrigations in all but even so a great percentage of the first flower crop was shed. Pickings started in mid August. Acreage variety and yield are shown below:—

Variety.	Acreage.	Yield in lbs. seed cotton.
Mesowhite (Webber 49)	144	23,396
Hartsville (Webber 49-3)	32	8,850

III. MISCELLANEOUS.

Flax.

20 acres of Yeovil flax were sown in February.

The crop was uprooted in May after 5 irrigations, it then averaging $2\frac{1}{2}$ feet high. Samples were retted and scutched and appeared to be satisfactory when the inexperience of the labour and Farm Staff in handling the crop are considered.

Fodder.

Twenty acres of Bersim sown at the end of February made a poor crop and was replaced by lucerne. This suffered due to late sowing, but it later picked up and made a good stand from which cuttings have been made during the cold weather for feeding to stock.

Single Line Barleys and Wheats.

Labour was provided as necessary to the Botanist for this work, a report of which will be found elsewhere.

Trees.

The Botanist was supplied with labour for Tree Nursery work, and under his supervision a number of trees were planted out on the Farm. Of these Persian Lilac, Willows, Poplars, Mulberries and Shisham have done well but Bombox has failed to withstand frost.

(F) ENGINEERING.

The whole of this work came under the Farm management on the departure of the Agricultural Engineer at the end of March.

The completion of the main well and the building of General Manager's bungalow, clerks' quarters, Research Office, Workshops and Tractor shed, were taken in hand by the Public Works Department and finished during the year.

At the main well a 30 H. P. Crossley Engine and a 30 H. P. Keighley Imperial were erected in April as well as the 20 H. P. Ransome Engine which was brought from the Cotton Farm. In addition an 11 H. P. Crossley and a $6\frac{1}{2}$ H. P. Blackstone were erected on other sites. Two tractors, a Fordson and an Austin, have been bought for Farm use and have worked well on the whole.

A Ransome's wooden thresher was received on the Farm, and all wheat and barley was threshed with this machine which is, however, unsatisfactory due to the tendency to warp in hot weather.

The tractor-draft ring-press rollers and disc-harrows have proved themselves very useful implements.

The motor transport of the Farm consists of a 30 cwt. Albion Lorry and a Ford Vanette. Both have given valuable service but, owing to age, the cost of upkeep of the latter is becoming very high.

(G) CONDITION OF STANDING CROPS.

1. Research. The experiments newly laid out for the 1921-22 season are the following:—

   (*a*) Nutrient Test (wheats)
   (*b*) Wheat Varietal Test.
   (*c*) Wheat Irrigation Test.
   (*d*) Wheat after cultivation Test.

All have germinated well and are making good progress.

(H). PESTS AND DISEASES.

Crows, ants and larks, are the chief pests and all do considerable damage. Spotted boll-worm on cotton and stem-borer on maize are the most serious diseases to report during the year.

(I). LIVE STOCK.

The stock of the Farm was poor at the beginning of the year but as losses have occurred they have been made up by good young stock. Twelve Scindhi cows with three calves and a bull were obtained from the Military Dairy Farm. These will form the nucleus of a Dairy herd.

Owing to plentiful fodder and grazing all stock were in good condition at the close of the year.

(J). PERSONNEL.

All members of the staff have worked loyally and well throughout the year. The names of Messrs. Gopal Singh, Bhan Singh, Khalil Ibrahim and Ghulam Haidar are especially worthy of mention.

A. A. SUFI,
General Manager, Government Experimental Farm, Rustam.

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